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A DECISION SUPPORT SYSTEM FOR ALLOCATION OF THE MARKETING BUDGET TO PRODUCTS, SEGMENTS AND PROMOTIONAL TOOLS

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A DECISION SUPPORT SYSTEM FOR ALLOCATION OF THE MARKETING BUDGET TO PRODUCTS, SEGMENTS AND PROMOTIONAL TOOLS

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UNIVERSITY OF WARWICK

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DECLARATION

No portion of this thesis has been submitted in support of another degree or qualification from this University or any other Institute of Learning. Some of the research findings have already been published in conference proceedings (see Maier 1986 and Saunders and Maier 1988, as referenced in the Bibliography).

SUMMARY

This thesis is concerned with the development of a marketing decision support system (MDSS) assisting in the allocation of the marketing budget to market segments, products, and promotional tools. The concept is illustrated using a case example of a US company operating in the UK ethical pharmaceuticals market with emphasis on marketing to general practitioners.

The thesis is testing approaches to segmenting the GP market, which subsequently lead to the identification of seven market segments. The response to sales force effort, advertising and direct mail is then subjectively estimated for each product and market segment. When the estimates are transformed into a mathematical expression, a model is developed which, when optimised, leads to the allocation of the marketing budget.

This thesis aims to contribute to the marketing literature in two ways. Firstly, it attempts to extend work by Doyle and Saunders (1985) to link segmentation and implementation - allocation of the marketing budget in this case. Secondly, it aims to add to the body of decision support research by including the allocation of resources not only to products and promotional tools but also to market segments.

Chapter 1 INTRODUCTION

Marketing decision making has become much more sophisticated since availability of data for decision making is ever increasing in the late 1980s. Not the lack, but the utilisation of the wealth of data will be a problem as Little (1987, p.25) observed. Consequently, growth of model assisted decision making in the marketing area can be observed, for which Lilien and Kotler (1983, p.xv) stated five reasons:

1. The increased development of marketing decision support systems. These combine models with increasingly more accurate data.

2. Many more quantitative MBAs are becoming managers. They have the skills and desire to use such models.

3. Marketing theory is improving in its ability to explain the phenomena observed.

4. Implementation of marketing models is more widely reported and lessons may be learnt from their application.

5. Marketing budgets continue to rise, so that models support the manager's desire for increased productivity.

While the last point is not necessarily true across industries, one important factor for the increased utilisation of models needs to be added. The penetration of personal computers has made the use of marketing models much more convenient for the decision maker (Little and Cassettari 1984, p.46). The application of software such as Lotus 1-2-3 has eased the barrier by making managers hands-on users of computers. This increases their desire to use or even to develop models.

This thesis aims to link the opportunities presented in the availability of data and the advances in model building with the development of a marketing strategy. It is aimed to develop further the work conducted by Doyle and Saunders (1985), who developed a model describing the strategic marketing process (figure 1.1). They linked market segmentation, targeting, positioning and the resource allocation problem. Market segmentation was defined by Kotler (1984, p.252) as the act of dividing a market into distinct groups of buyers who might require separate products and/or marketing mixes, market targeting as the act of evaluating and selecting one or more of the market segments to enter, and product positioning as the act of formulating a competitive positioning for the product and a detailed marketing mix, including the allocation of resources of the marketing budget.

In their previous work Doyle and Saunders (1985) implemented the model to the stage of target segment identification. It is here intended to develop this model further, to include resource allocation to the target segments identified.

In consumer markets it is possible to segment markets based upon market research studies conducted on quota samples (Wind 1978, p.325) of a given population. Within well defined statistical boundaries it is then possible to assume that certain segments in the market exist. Following this step the implementation of such a segmentation study into proper targeting is very difficult indeed. Where are the members of the target market and how can they be successfully approached?

Based on the access to a comprehensive commercial database - which was compiled to allow accurate targeting in the British Pharmaceutical Industry - this inherent problem of segmentation in consumer markets can be overcome. Since it is feasible to relate the findings of a segmentation study based on the database back to the other information held on the database, valuable information on how to approach members in certain segments can be extracted. This is even more important when, as in the case described here, the database covers large parts of the population.

The database available for this work can be treated as an example of many new databases which will become available in the not too distant future. Developments in the credit card area and, at the retail-level, developments regarding EPOS or EFTPOS demonstrate the likely potential of powerful databases. Availability of this kind of data will bring an important link between market segmentation, market targeting and targeting of the individual buyer in a target market segment.

This thesis aims at linking segmentation and targeting with the implementation of a marketing strategy. This is the allocation of the marketing resources (manifested in the marketing budget) to products, media and segments. Thus, the work reported in this thesis intends to bridge the gap between model building and implementation.

Based on a case study in the pharmaceutical industry the following hypotheses will be tested.

H1 __Segmentation can be used to allocate sales effort__

Wind (1978) in his discussion of approaches to segmentation refers to a number of bases for segmentation and reports a number of applications of segmentation as displayed in table 1.1. No reference is made to sales applications. This negligence is typical of segmentation research. By testing this hypothesis it is hoped to contribute to segmentation research in discussing the relevance of sales force allocation in the context of segmentation.

H2 __Such segmentation procedures can be implemented in practice__

The implementation of a successful segmentation procedure will often lead to a change in decision making (Schulz and Henry 1981). However, the implementation of segmentation is neglected in the literature (Saunders and Maier 1988), thus it is important to report on issues related to implementation.

H3 __It is possible to define market segments on the basis of response to marketing stimuli__

Market segmentation aims at identifying groups of customers within the market which behave similarly relative to their buying behaviour. Marketing expenditure aims at changing this very buying behaviour. In order to allocate the marketing budget effectively, groups of customers with similar response to marketing stimuli need to be identified. As far as the allocation of the marketing budget is concerned, the ultimate basis for segmenting a market is dynamic behaviour - the response to marketing stimuli.

H4 <u>It is possible to define static segments which reflect dynamic behaviour</u>

In terms of implementation, it is rather difficult to measure dynamic behaviour. Consequently, a particular problem is the availability of data since it obviously does require a fairly long time horizon to compile the relevant information. Therefore it is often not practical to use dynamic behaviour as a direct basis for segmentation. This thesis aims at testing whether static bases, i.e. based on data collected at only one particular moment in time, can be used as a proxy for dynamic behaviour and thus can function as a meaningful basis for segmenting markets.

H5 <u>A model can be used to support the optimum allocation of the marketing budget across products, segments and promotional tools</u>

Budget allocation problems are usually addressed in terms of allocation across products and/or promotional tools such as advertising, sales force expenditure and direct mail. This hypothesis aims at testing whether a model can be developed to assist in the allocation of resources across previously identified segments, products, and promotional tools.

The thesis is divided into ten chapters. Since this work is concerned with improving decision making, contributions made by research into decision support systems form an important foundation for achieving this objective. Therefore chapter two reviews marketing decision support systems. Particular emphasis is given to the components of a marketing decision support system and its development process.

Chapter three describes the specific situation upon which the hypotheses are tested. The pharmaceutical industry is described, the role of the doctor as the 'buyer' in the prescribing process discussed, and the tools highlighted which are available to pharmaceutical companies to influence the prescribing process, including advertising, sales force and direct mail.

Within this framework a specific case is illustrated and the data upon which the subsequent analyses are based are described.

Chapter four provides a brief review of the literature on market segmentation. Due to the hybrid situation in the market under examination, approaches to segmentation in industrial and consumer markets are illustrated.

Chapter five reports the results of an approach to dynamic, or response based, segmentation. It is explained to segment the market according to similarity in response to marketing stimuli over time. Based on an outline of the methodology, the results of the approach to response based segmentation are discussed.

Chapter six reports the results of an approach to static market segmentation. Based on the outline of the methodology, results of what are called macro-analysis and micro-analysis are reported and validated.

Chapter seven creates the foundation for developing a model allocating resources to products, segments and promotional tools. The literature on marketing decision models is reviewed to identify approaches to solving the problem identified in this case.

Chapter eight presents the application of a model allocating resources - the marketing budget - to segments identified previously, to products and to promotional tools. Based on the model specification, parameterisation and optimisation are explained. The findings are displayed and discussed.

In chapter nine, issues related to implementing the findings are addressed. Implementation is discussed according to the three main streams of this thesis: market segmentation, targeting and budget allocation.

The role of chapter ten is to summarise and to conclude on the findings presented in this thesis. Primarily the findings are discussed in the light of the five hypotheses tested. However, the limitations of this thesis are highlighted and areas for further research identified.

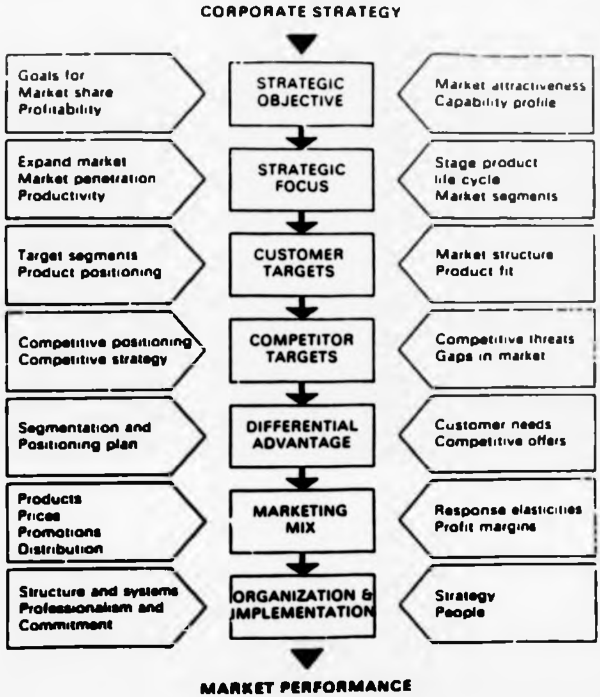


Figure 1.1 The components of strategic marketing
(as presented in Saunders and Wong, 1985)

BASES	APPLICATIONS: Understanding the Market	Positioning	New Product Concept	Pricing Decision	Advertising Decision	Distribution Decision
Benefits	/	/	/		/	/
Purchase and Usage	/	/				
Needs	/					
Brand Loyalty	/					
Product Preference		/				
Reaction to New Concepts			/			
Price Sensitivity				/		
Deal Proneness				/		
Price Sensitivity by Usage				/		
Media Usage					/	
Psychographic					/	
Store Patronage						/
Hybrid	/	/			/	

Table 1.1 Preferred bases for segmentation (based on Wind, 1978)

Chapter 2 MARKETING DECISION SUPPORT SYSTEMS (MDSS)

2.1 Introduction

This thesis intends to test the hypothesis H5 which states that a model can be used to support the optimum allocation of the marketing budget across products, segments, and promotional tools.

The decision to allocate the marketing budget in an organisation usually lies with the Marketing Director or the Marketing Manager. In testing the above mentioned hypothesis H5 it is important to understand the tools currently available to the decision maker.

Increasingly popular in application and academic literature have been decision support systems (DSS). DSS are systems developed to support managers' decision making processes in complex and ill-structured decision situations (Keen and Scott Morton 1978). Considering the complexities of a budget allocation process, a DSS could be of considerable value to the Marketing Manager.

The function of this chapter is to review the literature on decision support systems and, more specifically, those related to marketing, marketing decision support systems (MDSS). The objective is to demonstrate how the work reported here fits in with the literature on decision support systems.

The first section is aimed at reviewing the literature on DSS. The second section is more specifically concerned with the various components of an MDSS and how an MDSS is a special form of a decision support system.

In the third section some comments are made about the importance of more recent developments in the adoption of microcomputers in relation to MDSS acceptance. The fourth section then discusses development processes with the view to a successful implementation of an MDSS.

Finally, the conclusions drawn from the literature review are summarised and an outlook for future development is provided.

2.2 Decision Support Systems (DSS)

Since Gory and Scott Morton (1971) introduced the term 'decision support system' not much progress has been made in ultimately defining what a DSS actually is (Sol 1987, Keen 1987). However, it is claimed that the DSS 'movement' has made a major contribution to improve the performance of information workers through the application of information technology during the past decade with an even more promising role in the next (Sprague 1987).

An important influence to the DSS thinking was Little's (1970) introduction of the decision calculus concept. He defined a decision calculus as a model-based set of procedures for processing data and judgements to assist a manager in his decision-making. Sprague (1980, p.8) called a DSS an interactive computer-based system which helps decision makers utilise data and models to solve unstructured problems. Keen and Scott Morton (1978) developed a widely accepted definition in which they emphasised the assistance for managers in semi-structured tasks in order to improve the effectiveness of decision-making. Alter (1980, p.xi) pointed out the importance of a quick response to the changing needs of decision-makers.

Numerous authors have contributed their ideas. An overview was given by Ginzberg and Stohr (1982). These additions have led to the inclusion in the definition of a DSS of any system that makes some contribution to decision-making with the consequence that the term can be applied to all but transaction processing (Sprague and Carlson 1982, p.4). This is demonstrated by a definition brought forward by Freyenfeld (1984, p.10) who wanted to apply this term to all decision-making and hence excluded the phrase "manager" and replaced it by "decision-maker". The majority of authors, however, places the decision level at a high level in the hierarchy; some put it as high as the chief executive. Therefore, it seems to be reasonable to include the term "manager" in the definition. The discussion has led to some rather critical comments which pointed out that DSS is a redundant term and which criticised the missing conceptual framework for DSS (Naylor 1982).

In order to attempt a useful definition it is helpful to describe the role of DSS in the light of conceptual frameworks which preceded the developments of DSS namely, Management Information Systems (MIS) and Operational Research/Management Science (OR/MS).

Keen and Scott Morton (1978, p.1-2) contributed the following distinction:

(a) MIS
The main impact has been on structured tasks, where standard operating procedures, decision rules and information flows can be reliably pre-defined. Data are typically used in the context of repetitive, routine transport and report generation (Bonczek et al 1982). The main payoff has been in improving efficiency by reducing costs

(Kleijnen 1984; Carter 1984) and replacing clerical personnel.

The relevance for managers' decision-making has mainly been indirect, for example by providing reports and access to data. Thus the MIS is designed to deal with the "overload of information" (Holzhauer 1984) and the "management" or administration of information (Sizer 1983).

(b) OR/MS

The impact has mostly been on structured problems (rather than tasks) where the objectives, data and constraints can be pre-specified. The payoff has been in better solutions for given types of problems. The relevance for managers has been the provision of detailed recommendations and new methodologies for handling complex problems.

(c) DSS

The impact is on decisions in which there is a sufficient structure for computer and analytic aids to be of value but where managers' judgement is essential. The payoff is in extending the range and capabilities of managers' decision processes to help them improve their effectiveness. The relevance for managers is the creation of a supportive tool under their own control, which does not attempt to automate the decision process, pre-define objectives or impose solutions.

In the absence of a clearly defined conceptual framework, with the exception of a trial undertaken by Sprague and Carlson (1982, Chapter.2), the term decision support system (DSS) shall be used in this work to include the following aspects:

- when the objective is to improve the effectiveness and productivity of managers
- where in an interactive process it assists rather than replaces managerial judgement
- where it supports decision processes in semi-structured tasks without automating the process
- when tasks to be solved have several features (Keen 1981, p.3):
  - they are non-routine and involve frequent ad hoc analysis
  - they often address "what-if" questions
  - they have no correct answers.

With Bennet (1983, p.3) it can be concluded that the purpose of a DSS cannot be achieved without impact on the process of decision-making and on the behaviour of the decision-maker. Recent contributions (Henderson 1987, Wang and Yu 1987) draw the attention to synergy between DSS research and the development of expert systems.

Stabell (1987) in an attempt to structure the various 'DSS schools' distinguished four approaches to DSS research. Firstly, decision analysis with the focus on how to make decisions. Secondly, the decision calculus approach with the focus on the decision situation and the goal of better decisions through better models of the decision situation. Thirdly, decision research with the focus on the decision process and the decision maker. Fourthly, the school of implementation process with its obvious emphasis on implementation issues. Stabell (1987, p.250) acknowledged the existence of a further, different approach to DSS research with its emphasis on DSS technology, including DSS generators and design methods.

Table 2.1. summarises the different approaches of the various schools and highlights the important aspects for the decision calculus approach including repetitive decisions and the reference discipline of operations research.

These distinctions between the various schools are of relevance in the context of this thesis in that Stabell (1987, p.246) pointed out for marketing problems the particular relevance of the decision calculus approach.

Consequently, as far as decision support systems are concerned, the focus of this thesis shall follow very much the 'school' of decision calculus.

To meet the purposes outlined above certain requirements for an evaluation (Armstrong and Shapiro 1974) need to be met. The requirements for a DSS have been formulated by Little (1970, p.B-470). He suggested that a DSS should be simple, robust, easy to control, adaptive, as complete as possible and easy to communicate with. By simple is meant easy to understand; by robust, hard to get absurd answers from; by easy to control, that the user knows what input data would be required to produce desired output answers; adaptive means that the model can be adjusted as new information is acquired; completeness implies that important phenomena will be included even if they require judgemental estimates of their effect; easy to communicate with means that the manager can quickly and easily change inputs and obtain and understand the outputs. The importance of the DSS language used is stressed by Meador and Mezger (1984).

DSS were introduced in various fields and for various applications. An overview was given by Keen (1981). First applications occurred in financial planning and in marketing, as well as in non-commercial applications such as police beats and urban planning (Sprague and Carlson 1982, p.22).

It is rather difficult to assess the benefits of using a DSS. Keen (1981) suggested the use of a value analysis rather than the common cost-benefit approach since the latter requires an accuracy which can by definition not be present at semi-structured tasks. However, he cites a few benefits some of which are difficult to measure or difficult to quantify:

- increase in number of choices examined
- better understanding of the business
- fast response to unexpected situations
- ability to carry out ad hoc analysis
- new insights and learning
- improved communication
- control
- cost savings
- better decisions
- more effective teamwork; development of group decision support systems (Huber, 1984)
- time savings
- making better use of data resources.

There is still a discussion whether the use of a DSS really leads to "better" decisions. An evaluation of judgement-based marketing models was undertaken by

McIntyre (1982) and by McIntyre and Currim (1982, p.204). Their findings include that a decision calculus model does not improve the ability to estimate response functions and that a decision improvement (when there is one) is due to a better integration of judgements. They concluded that, although that the model clearly helped on average, it certainly did not help every user to perform better than every non-user.

In a study Fudge and Lodish (1977, p.104) determined that a group of employees using a DSS achieved 8.1% higher sales than a control group not using it. The same authors report other successful implementations (Lodish 1981). Other studies (Chakravarti, Mitchell and Staelin 1979, 1981) pointed out the limitation of ADBUDG, a DSS for advertising budgeting. They concluded that decision-making was not improved. In a reply, Little and Lodish (1981), pointed out the limitations of the study, but agreed that ADBUDG is not robust.

There is no final conclusion to this topic but there are indications that an improvement in decision-making can be achieved mainly due to the benefits gained during the model building process, giving decision makers insights which are often non-quantifiable.

Therefore, it is no surprise that the market for DSS has expanded (Maher 1984). Today's DSS have evolved either from financial modelling systems or from database management systems (Seils 1982). Systems are becoming more sophisticated and are able to handle multi-dimensional problems (e.g. systems in the UK supplied by Comshare). The lack of a clear DSS definition is reflected in the type of DSS packages offered on the market. Briggs (1982) counted more than 70 packages with the spectrum ranging from Visicalc for $200 to more sophisticated systems exceeding $200,000.

Keen (1987) was concerned about the balance within the term 'decision support system'. He claimed that too much effort is actually put on 'support' without addressing its strategic implications or on 'systems'. For the latter emerging technologies such as document based DSS, expert systems, and telecommunications should, however, should not be overlooked to avoid possible bottlenecks in the progress of DSS development.

Keen (1987, p.259) stated that 'decision' defined as the nontechnical functional and analytical aspects of DSS and the criteria for selecting applications, are currently the bottleneck.

2.3 Marketing Decision Support Systems as DSS

Little (1979a, p.1) defined a marketing decision support system as a co-ordinated collection of data, systems, tools and techniques with supporting software and hardware by which an organisation gathers and interprets relevant information from business and the environment and turns it into a basis for marketing action.

He described a data bank, models, statistics, optimisation and communication as the elements of an MDSS. In the data bank, the data on major marketing variables such as sales, advertising, price and promotion in a sufficient detailed form are provided. Models represent the behaviour of the real world phenomena. Those of interest here find explicit mathematical and computational representation. A classification of different models was provided by Zoltners (1981). He distinguished descriptive models, which attempt to provide detailed and accurate representation of the marketing phenomena under investigation; predictive models, which are concerned with forecasting outcomes of specific marketing decisions, plans and events; and also normative models which provide a basis for choosing a good, possibly even optimal, strategy from among alternative courses of action.

While Naert and Leeflang (1978, p.42) foresaw that future models will be of the predictive and descriptive, rather than the normative variety, Zoltners (1981, p.68) pointed out the advantages of normative models. These are:

- significant opportunities may be overlooked when not looking for the "optimal" solution
- loss of credibility for the model builder if a better solution emerges without the use of the model
- without optimisation it is meaningless to perform sensitivity analysis or "what if" questions
- optimisation allows the tracking down of input errors.

There are several drawbacks with the use of normative models:

- reality may be too complex to be incorporated in a model or the model might be an imperfect representation of the real world
- they tend to preclude the incorporation of managerial judgement
- the user might feel uneasy with the model produced solutions, especially if he does not trust the model.

There has to be a trade-off between the validity of the model and its acceptability. On the one hand the model will lead to better decisions if it represents all real world phenomena and on the other it should be used. Since managers like to be in control of their decisions they are less likely to accept a model that produces optimal solutions. Therefore, descriptive and predictive models might be more easily implemented in a managerial context.

Statistics are the third component. The relation of models to data shall be called statistics. Manipulations such as aggregation, grouping and comparisons are handled in this section. Optimisation applies to all cases when a manager tries to improve the performance of the company. This can be done by formal management science methods such as linear programming. The fifth component is the interface between manager and system. Tools have to be provided to assure an effective and efficient communication. This relates to input as well as to outputs such as reports (Little 1979a, p.10).

There are several problematic aspects of the marketing system which make it difficult to predict the market response to variations in the marketing effort (Lilien and Kotler 1983, p.6).

(a) Sales response to a single marketing instrument

The relationship between the market's response and the level of marketing input is typically unknown. It is a challenging task to summarise the behaviour of individual buyers at various stages of awareness, interest and intention into a measure of total sales response.

(b) Marketing-mix interaction

Marketing effort such as pricing, personal selling, advertising, sales promotion or product development has to be combined in a sound mix. There is great uncertainty about the separation of joint effects. The result of a variation of any one of the elements is difficult to measure.

(c) Competitive Effects

The market's response is related to the competitors' efforts as well as to the company's own efforts. It is difficult to foresee the moves of competitors.

(d) Lagged Response

The response to marketing effort is, in most cases, not immediate, but occurs in a later time period than the initial expenditure. The carry-over effects create a problem in the timing and distribution of marketing expenditures over a planning horizon.

(e) Multiple Territories

Typically there is a different rate of response to marketing effort in each territory a company is operating in. It is difficult to assess the allocation of expenditure to territories due to the question of whether to spend in areas in which the firm is already doing well or in others which require development.

(f) Multiple Products

The allocation of limited funds to a range of products is another problem. The marketing strategy has to take into account the interaction among products. For example the raising of price for one product might lead to an adverse response for another.

(g) Functional Interactions

There is a need for joint decision-making in the areas of marketing, finance and production. If a demand created by promotional programmes cannot be satisfied due to restrictions in production this can lead to an adverse response of the market. The same is true with the co-ordination between finance and marketing, i.e. in the case of product innovation failure.

In the light of the problems described above it is obvious that it is a very ambitious task to model all the relevant aspects in marketing decisions. This is documented in the fact that most models developed so far concentrate on specific aspects of marketing decision making. There are rarely any complete models available and, if so, their usefulness has to be questioned. Therefore, some authors argue that caution is necessary in the use of models (Troll 1983).

Others (e.g. Friesenwinkel 1984) point out that certain limitations should not prevent model building since a new insight into the inter-dependencies of decision variables is provided.

Weinberg and Montgomery (1973, p.26-28) discuss three uses of models in marketing. Firstly, as an aid in exploring the anticipated consequences of a broad range of decision alternatives. Secondly, some models provide a built-in ability to search for decision alternatives and finally the use of models allows the consideration of what might otherwise be politically unmentionable.

2.4 MDSS and the Microcomputer

The experience gained with the use of DSS has led to an increasing number of DSS-applications. Especially, with the evolutionary process of the microcomputer which has enhanced the use. Treacy (1985) gives an overview of the shift in hardware for DSS to the personal computer.

When, in the early 1970s, Montgomery et al (1971) reported the use of an interactive computer system on which they ran their DSS, this was supposed to be an exception. At that time most data processing systems were centrally located, and batch processing was the state of the art, making it very difficult for a manager to use it for decision support.

A DSS will only be used when the manager has easy access to it. With the evolution of distributed data processing it became easier to access a computer. During recent years the microcomputer has become a common tool for managers (Lewis 1984).

This widespread and rapidly expanding diffusion has changed the way managers think about computers in general (Meador et al 1984, p.117). They are more pro-active in their interest and less resistant to the idea that they themselves can be "hands on" users. They hear about software tools like Visicalc or Lotus 1-2-3 that make it easy for computer novices to begin building models and incorporating more quantitative analysis approaches into their planning and decision-making.

In addition to the change in attitude the increase in power of microcomputers enhanced the use of DSS. Microcomputers can handle tasks that were thought of as only feasible by use of a mainframe. Healy (1983) draws a very optimistic picture of the opportunities for microcomputers. However, even if in disagreement with his view, the increasing capacity of micros has broadened their utility significantly. Today it is possible to run versions of mainframe DSS on a micro.

Additionally, there are opportunities to connect the micro to a mainframe (Ferris 1983). Thus, the advantages of a mainframe, namely data administration, overall intelligence about the distributed complex, high powered computation, and storage of the master data bases, are combined with the easy, distributed and independent access to the micro (Crandall 1983, p.19).

The linking of micros to networks offers new opportunities too. Nevertheless, there are still quite a few difficulties, concerning data formats, etc., to overcome, but the problems should be solved in the foreseeable future. (Little and Cassettari 1984, p.46)

In a survey Higgins and Opdebeeck (1984, p.251) found that the microcomputer is not to replace the mainframe, but is rather used for ad hoc modelling at all management levels, for independent modelling purposes which do not rely on a central data base, and for certain top management confidential data manipulation.

Vandermerwe and Carney (1987) found in a European survey that 74% of marketing executives were daily users of PCs. They concluded that this high usage rate demonstrates a good potential for future applications in the MDSS area provided that the users are better involved in the initial planning stages of an MDSS.

2.5. The MDSS Development Process.

Case studies provide evidence that the actual uses of DSS are almost invariably different from the intended ones (Keen 1980). Consequently, it has been pointed out that "adaptive" design and development is important to a successful implementation of a DSS (Meador et al 1984, p.118). Keen (1980, p.15) stressed the following reasons:

- the designer or user cannot provide functional specifications

- the user's concepts of the task or decision situation will be shaped by the DSS which in turn is shaped by the user

He concluded that an initial system must be built quickly to give the user something upon which to react.

A flexible DSS may not only allow personalisation as far as the user is concerned but may also provide a variety of options which are particularly desired by risk-averse users (Zinkham et al 1987).

A study (Alavi and Henderson 1981, p.1320) supported the hypothesis that an evolutionary implementation strategy is more effective than a traditional strategy.

How a successful implementation can be achieved shall be described by examining different steps of the model building process. The second section shall relate the theoretical view to the steps actually undertaken and shall specify the requirements that have to be fulfilled by an MDSS to be implemented.

There is an overall agreement in the literature that the development process is crucial to the success of a DSS. In an empirical study Ginzberg (1979) showed that success in implementation efforts is positively related to the implementation process. The importance of user involvement is stressed in the literature (i.e. Meador et al 1984). In a survey Alter (1978) detected that only in less than one quarter of the cases in his sample the systems were initiated and implemented with the user's active participation. However, Mann and Watson (1984) argued that user involvement can vary according to DSS technology, the management activity and the nature of the task interdependence.

There are numerous approaches to the implementation process. A discussion can be found in Schultz and Henry (1981). One example of the development process shall be explained in more detail. The overall flow of the process formulated by Urban (1974) is described in figure 2.1. This process was used as a guideline for implementation of many DSS. It is important to understand the single steps as being iterative rather than treated in isolation.

a) Formation of priors

The model builder needs to have a tool kit of OR/MS and statistical techniques, as well as a number of alternative model building approaches, so that he/she can effectively solve problems. It is important that the problem leads to decision models and not that the problem is forced to fit the technique. This approach is quite difficult to achieve since every model builder has his or her priors and is biased towards one approach without realising it. However, the model builder should consider a range of general models that could contribute to the real problem area in order to make an effective entry.

b) Entry

It is recommended that entry is made at the decision point to work with the decision level as soon as possible. The managers are required to understand modelling vocabulary and at best get some hands-on experience with models. The team has to be set up and commitment of time, personnel and resources is crucial to the success of the project. The importance of top management support has been pointed out by several authors (e.g. Sanders and Courtney 1985, p.87).

c) Problem Finding

In order to avoid having to solve a problem that does not exist, substantial effort is needed to define a problem correctly. Among other aspects Urban (1974, p.5) suggests carrying out studies to determine:

- existing models or rules of thumb
- the characteristics of the decision making process
- the existing flow and usage of information
- the stated and apparent goals of the organisation
- the information and formal organisation structure
- managers' definitions of their perceived problems
- the basic issues underlying current crises.

After the assessment of the situation a single project should be selected. It has to be simple, visible and significant in order to achieve a solution, gain recognition and provide a basis for future work.

d) Specification of model development criteria

First a decision has to be made whether the model is descriptive, predictive or normative. A specification of criteria relating to model's purpose and scope should be set. This has to be done in addition to the criteria set by Little (1970) which have been explained in section 2.2.

e) Model Building

The actual model building is considered to be a kind of art. According to the problem and the criteria, the market characteristics are modelled. An iterative process is necessary until the characteristics are modelled correctly.

f) Estimation and Fitting

Data for model building can come from past data, subjective estimation or experimentation. Accordingly, empirical and subjective (Naert and Weverbergh 1981) or judgement-based (La Forge and Cravens 1985) models are distinguished.

In many cases past data are not available or neither the quality nor the quantity of past data is sufficient. Experimentation is in many cases too costly. Thus, subjective estimation is often the only way to produce data. This is especially true in marketing, where responses to marketing tools can often just be judged. See Saunders (1985) for a detailed description of the use of subjective estimation.

g) Tracking.

Tracking is a method where past data are used to test whether the model meets actual results. The analysis of differences in the outcome provides an insight into the causes such as errors in the forecasting inputs, inappropriate parameter estimates, incorrect model structuring or random variation.

The analysis of differences, therefore, is important to the manager and leads quite often to the specification of new models or data needs. The aim is to establish the model's validity.

h) Continuing Use

With continuing use, tracking increases managers' confidence in the DSS and usually leads to elaboration and evolution. The model also needs to be updated in order to meet the changes in the environment. Training and maintaining commitment are necessary, especially when staff changes occur.

Taking this description of the model building process it is obvious that much time and effort has to be spent on other issues than the actual formulation of the model.

2.6 Summary

As far as this thesis is concerned, it is the objective to test the hypothesis that

> 'A model can be used to support the optimum allocation of the marketing budget across products, segments and promotional tools'.

The budget allocation process is a semi-structured task, hence an area for which decision support systems might be suitable.

This chapter has looked at MDSS as a special form of a decision support system. DSS's objective is to assist rather than to replace managerial judgement. This is of particular importance in marketing due to complex and often inter-related decisions especially with budget allocation decisions. The applications of MDSS have increased in recent times due to the advent of the microcomputer. Suddenly decision makers themselves have access to, and are gaining the experience with, computers. Standard packages such as Lotus 1-2-3 allow the assessment of "what if?" questions and ease model building.

Following the 'DSS school' of decision calculus the development of models is the focus of this thesis. However, the use of models does change the behaviour in decision making. Hence, resistance to change should not be underestimated. Therefore, particular care is required in developing marketing decision support systems.

For the future Little and Cassettari (1984 pp 45-47) predicted:

- An increase in the amount of data used. MDSS will have to be able to support the decision making in a time in which the amount and quality of data are ever increasing (EPOS, panel information).

- A dramatic increase in computer power which will enable more complex analysis. The development of new computer languages as well as expert systems will create a shift from analysing the market status to market response reporting.

- The use of the microcomputer enabling the decision maker to become hands-on user.

- The development of local area networks (LANs) linking micros with mainframes will increase the utility of MDSS.

- Changes in management style will be possible, enabling managers to have a much deeper understanding of the responsiveness of their market. This will lead to a more creative approach to marketing since new ideas will be tested immediately.

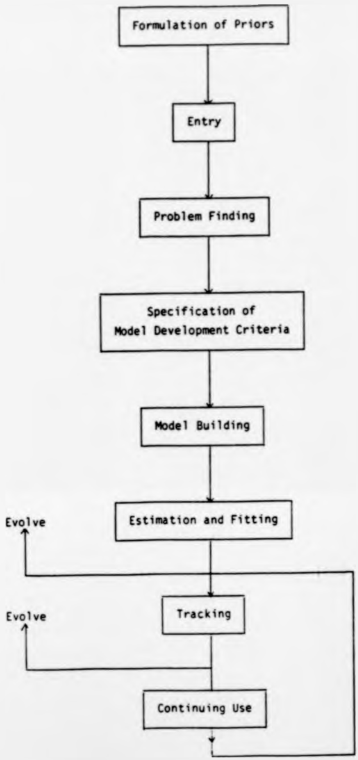


Figure 2.1 DSS development process (Urban 1974)

	Decision Analysis	Decision Calculus	Decision Research	Implementation Process
Type of decision situation	single shot	repetitive	repetitive	? (single shot)
Focus in decision process	choice	problem solving choice	whole decision cycle	?
Primary aims	consistent decisions	better model	effective decision process	use of support system
Learning	conditional probabilities	model of decision situation	DMr & decision process	support system
Handling lack of structure	impose a structure	structure	explore lack of structure	? (test structures)
Focus in DSS development process	analysis	design	analysis	implementation
Reference discipline	micro economics	OR	decision making in organisations	'consulting' OD

Table 2.1 Schools of DSS research (Stabell 1987)

Chapter 3. BACKGROUND TO THE CASE

3.1 Introduction

In the previous chapter the elements of an MDSS have been explained. In this chapter the objective is to highlight the importance of an MDSS in the UK pharmaceutical market and to provide the background to the case upon which the work reported here is based. Strong Governmental regulations have culminated in a unique market situation in the UK. Thus, to outline the environment in which the MDSS is to operate, the pharmaceutical market in the UK is described. Particular emphasis is given to ethical pharmaceuticals prescribed by General Practitioners (GPs).

The first section comprises an analysis of factors influencing the supply and demand for drugs. Then, in the second section the prescribing process of individual GPs is related to research into buying behaviour. The tools available to pharmaceutical companies to influence the prescribing process are outlined in the third section. The fourth section is a brief discussion of findings about the effectiveness of the various promotional tools. The fifth section describes a case and the underlying problem. The sixth section is dedicated to explaining the kind of data used to conduct the research reported here. Finally, in the last section, the main findings of this chapter are summarised and related to the aim of developing an MDSS for the pharmaceutical industry.

3.2 The Pharmaceutical Industry

The pharmaceutical industry in the UK is one of the rapidly growing sectors of the British manufacturing industry. With an average growth rate of 4.9% between 1970 and 1982, the growth in the industry was considerably higher than in the chemical industry and in the manufacturing industry as a whole (Jordan's Report 1984, p.2). Since the early 1980s the industry' production has grown by some fourty per cent (ABPI 1988, p. 4). To explain the forces in this successful industry, supply and demand factors are explained and the lines of communication in the industry described.

3.2.1 Supply Factors

3.2.1.1 Market Size

With 3.5% of the world market for human pharmaceuticals the UK pharmaceutical market ranks sixth in the world. In the UK production was £4.283 billion in 1987, of which 39% was exported. Imports amounted to £856 million (Business Monitor 1988).

3.2.1.2 Market Segments

The pharmaceutical market can be divided into segments for veterinary products and for human medicine. The latter segment can be split into the ethical drug market - medicine that is available on prescription only - and into the over the counter market (OTC-products), products that are available without a prescription. 80% of sales in the UK are accounted for by the National Health Service (NHS).

In 1948 the NHS came into existence. It extends to all residents, irrespective of age, sex, and contribution to the scheme. Thus, economic barriers for reception of health care are removed (Pradham 1983, p.199).

The NHS market for prescription drugs has three components. The segment of general practitioners accounts for 75%, hospital sales for 21% and dispensing doctors for 4% of the total (Jordan's Report 1987, p.11).

The traditional prescription market is different to other markets in that the final customer is not making the buying decision and is not paying for it either. The decision to "buy" the drug is made by the doctor, while the NHS pays for it. There is no direct relationship between the seller and the final customer.

Taylor (1983, p.15) identified four sets of factors which distinguish the prescription market from any ordinary market situation. Firstly, the utilisation of third party payment (i.e. state or insurance company). Secondly, the "agency" relationship. Required by law or due to a lack of knowledge, sick people need to appoint a doctor or a pharmacist as their agent and will follow his or her advice relatively uncritically. Thirdly, the emotional response of a sick person to those who provide care will be quite different from any other buying situation. Fourthly, intervening forces such as laws and professional and voluntary codes mean that the medical market is removed from any simple type of free market.

The complex relationships are summarized in figure 3.1. This diagram indicates the interaction of the health care consumer, the doctor and the medicine producer considering the involvement of Government, wholesalers, pharmacists and professional bodies. It is obvious that the doctor as the decider and the Government, responsible for the payment, are not involved in the flow of the product. Flow of information and the "agency" relationship are well illustrated in the diagram.

In order to cope with increasing costs in the health sector in 1983, and more dramatically in 1985 the government took drastic steps: it introduced 'the limited list', a listing of those products for which re-imbursement by the NHS is provided. Consequently, a new segment has evolved; the segment of products that are available on prescription only but have to be paid for by the consumer. This segment can be called the "private prescription market". OTC-products in turn are being paid for by the final consumer, without the involvement of doctors and the Government. Figure 3.2 describes the pattern of the three major segments.

Supported by a general trend toward self medication and an increase in private health insurance, an increasing involvement of the final customer leading to a more cost conscious buying behaviour, can be expected. Thus, shifts will include growth of the OTC-market and the segment of the private prescription market. (Jordan's Report 1987, p.5).

As is later described in section 3.5, the problems addressed in this thesis primarily relate to the ethical drug market. The emphasis shall be on the segment of GPs as the biggest segment in the Uk's ethical drug market.

3.2.1.3 Competition

Many companies in the pharmaceutical industry operate on a worldwide basis. Hence, economy of scale effects can be achieved in recovering large investments in R + D projects. Periods of ten to twelve years for the development of a drug are common and require an investment of between £50 and £100 million (ABPI 1985, p.17). In 1983 Hoechst AG as the largest drug company had a worldwide turnover of $2.55 billion while the fifteenth largest, Takedo, achieved $1.3billion (The Economist 1985, p.75). This relatively small difference indicates that there is no one single company which controls the world market.

These international companies compete with hundreds of smaller companies in each country. For example in the UK Chew et al (1985) counted two hundred and twelve companies. The smaller companies usually serve only certain niches in the market. It was observed that the concentration within the industry, measured as market share of leading companies, has decreased. This observation is also made in Germany, Switzerland and the UK (Solc 1980, p.83; Slatter 1977, p.47).

In 1983 the eighty-five major pharmaceutical manufacturers in the UK accounted for ninety-five percent of prescription sales. Sixteen of these companies were British owned, thirty-six US owned and thirty-three European (Jordan's Report 1984, p.1).

The low concentration in the total market is not true for all segments of the market. For example, Beecham with approximately 5% total market share is assumed to hold a 90% plus share of the broad spectrum penicillin market (Jordan's Report 1984, p.11). This example shows that effectively competition can be fairly limited in certain product markets.

On the other hand, shifts in the ranking of leading companies indicate that it is quite difficult to maintain a leading position over a long period of time. These shifts are taken as an indication of a strong competition within the industry (ABPI 1984, p.37-41). The Association of the British Pharmaceutical Industry has obviously an interest in demonstrating the fierce competition in the industry, which will enable a better position in negotiating prices and terms with the Government.

3.2.1.4 Barriers to Entry

Legislation, patents, cost of research and development, and product differentiation create barriers to entry in the industry.

a) Legislation

As well as consistent quality control, licensing arrangements are subject to legislative influence (Hauptmann and Roberts 1985). The introduction of a new product is time consuming and costly due to the number and kinds of tests that are required (Martin 1981, p.46-56). Smaller companies may find it difficult to compete under the strict regulations.

b) Patents

With the Patents Act from 1977 the patent life in the UK was extended from sixteen to twenty years. During this period the firm which invents a new product is protected against generic copying and can recover the R + D investments. After the expiration of a patent generics, products using the same substances as the original product, can be introduced by competitors. These companies do not have to recover high R + D investments and are consequently able to offer the drug at a much lower price, imposing a major threat to the original manufacturer.

c) Research and Development

It is essential for many companies to develop new products themselves in order to obtain patent protection, allowing for higher margins. Only multinational companies are in the position to pay for basic research. Smaller companies are forced to channel their efforts into areas where a high probability for success is provided.

In recent years the sustained growth in research and development expenditures to £490 million in 1984 (ABPI 1985a, p.16) and to £668 million in 1987 (ABPI 1988, p.15) has not been accompanied by the launch of new products (Wells 1983, p.8). Steward and Wibberley (1980) found that the number of the most innovative introductions, new chemical entities (NCEs), is halved to 20 per annum compared to the 1960s. This trend has also been observed in most other countries (Rigoni et al 1985, p.18).

d) Product Differentiation

Brand names provide a unique identification of a manufacturer's products. Therefore, the reputation of a manufacturer is linked to the perceived quality of the medicine, creating goodwill. From a marketing point of view the aim is to create a monopoly type situation in a segment in order to exploit the benefits of a differentiated product compared with generics.

Brand names play an important role once the patent has expired. Then the reputation of the brand is the only shield against "branded generics", generics marketed under brand names, and "pure generics", which are marketed under the officially approved chemical name. Both types will usually be sold at a much lower price than the branded products.

3.2.2 Demand Factors

Not surprisingly, the aggregate demand for ethical pharmaceutical products is primarily dependent on the size and the composition of the population, the standard of living and the incidence of disease (Slatter 1977, p.21).

Additionally, demand is dependent on the economic and political environment. In particular, the kind of social security system influences the level of demand. Chew et al (1985, p.36) compared the systems in seven nations. In the US, for example, only 50% of the total population is covered by publicly funded health care schemes. The other half is either covered by private schemes or is required to pay directly. This situation obviously leads to a much more price conscious prescribing behaviour as opposed to a system as in the UK, where overall ninety-four percent of the cost of medicines is reimbursed. The demand for pharmaceuticals in a country is consequently dependent on the degree of reimbursement allowed under the national security system.

Clearly, these factors are outside the control of pharmaceutical manufacturers, but a manufacturer can influence demand by developing new products in order to meet latent demand.

For the market in the UK, important factors influencing demand are the role of the NHS and the prescribing doctors. These factors will be described in this section.

3.2.2.1 The influence of the NHS

In the UK forty-five percent of production is paid for by the NHS (Jordan's Report 1987, p.4). Since the expenses of the NHS have increased from £2,046 million in 1970 to £17,327 million with pharmaceutical services accounting for 9.8% in 1984 (ABPI 1985a, p.40), the NHS has tried to restrict the level of demand. Slatter (1977, p.23) called this policy "counter promotion".

Activities include the monitoring of doctors' prescribing habits, with the threat of imposing disciplinary arrangements if cost standards are not obeyed. Attempts have been made to inform doctors about opportunities of using cheaper generics instead of branded products. Since the doctor's independence is one of the basic principles built into the National Health Act of 1946, the efforts of the NHS in this respect have to be limited.

However, the NHS is in a strong position to negotiate prices. This is documented in the imposition of a price reduction by 2.5% and a price freeze until April 1984 in June 1983 (ABPI 1984, p.10). On the other hand, the bargaining power of the NHS is limited, since the existence of a competitive industry earning "normal" profits is in the public interest. With a surplus of 680 million in 1984 (ABPI 1985b, p.11) and of 835 million in 1988 (ABPI 1988, p.10), the pharmaceutical trade balance was a major contributor to the balance of trade.

The pricing policy is further controlled by the setting of a target for the rate of return in the industry of twenty-one percent. Additionally, under the terms of the Pharmaceutical Price Regulation Scheme (PPRS) the spending on promotion is limited to 9% of sales (APBI 1985a, p.8). Any overspending has to be paid directly to the government, in addition to being added onto profits. This affects especially smaller companies which might find it difficult to employ a sufficient number of medical sales representatives to visit their target group of doctors (Chew et al 1985, p.42).

3.2.2.2 The Influence of the Doctor

In the marketing of ethical pharmaceuticals the doctor is in the centre of the supply (industry) and demand (patient) interrelationship. He or she is the decision maker. Therefore, it is important to examine the factors that determine this decision. At this stage only a broad overview will be provided, the next section examines doctors' prescribing behaviour in more detail.

It can be assumed that the physician's decision to prescribe a product is led by the search for the superior product. Solc (1980) distinguished subjective and exogenous factors which influence the decision; subjective factors such as age, experience, scientific interest, etc. Exogenous factors include the kind of illness and the features of the product. Depending on the diagnosis, the doctor will prescribe the appropriate drug at the appropriate doses. Additionally, any inconveniences that have occurred during the previous therapy are taken into account.

Since the doctor's reputation is dependent on his/her success, it is important that the expectations toward a product are met. Usually, a medicine with which the doctor has experience will be chosen. In general, the prescription behaviour is best described as risk averse.

Other factors influencing the decision are, for example, the status of the patient (NHS or private insurance), the prescribing habit of colleagues, information provided in journals and by the industry.

O'Brien (1984, p.12) found that the remuneration policy has an impact on the prescribing policy of a doctor. He detected the highest average number of prescription items in countries where the doctor is paid on a "fee-for-service basis." Whereas in countries such as the Netherlands, Denmark or the UK the doctor is paid on a capitation principle and subsequently the lowest average prescription items are observed.

Although the emphasis in prescribing medicines is on performance, emotional appeals should not be ruled out completely. Smith (1975, p.66) described the relationships between the rational and emotional in physicians' motivation. Despite the rational self image of doctors, the image of a company plays an important role in their decisions. In this context Simon (1985, p.44) pointed out the role of goodwill as a barrier to entry for competitors.

3.3 The Prescribing Process

The focus in this section is on the examination of buyer behaviour at the micro level, taking an individual GP as the object under study. Since Doctors prescribe as individuals rather than as groups, it is reasonable to explain the behaviour according to the models developed to describe consumer behaviour. Where necessary the model is extended to incorporate elements that are unique to the GP market.

Findings of research into diffusion processes as far as the adoption of new drugs is concerned are related to GP's prescribing process in the second part of this section.

3.3.1 Prescribing related to Buying Behaviour Theory

Consumer buyer behaviour is classified according to the extent of involvement required. Involvement shall be defined with Engel and Blackwell (1982, p.24) as "the activation of extended problem-solving behaviour when the act of purchase or consumption is seen by the decision maker as having high personal importance or relevance".

They made the distinction between low and high involvement processes for consumer markets. The high involvement purchase decisions occur on fewer occasions. For example, the decision to buy a car. Low involvement decisions are for example, the decision to buy a certain dairy product. The process and the implication for a marketing strategy differ strongly between low- and high- involvement decisions. A high involvement process involves extensive problem solving and consequently, requires search for and use of information.

Howard and Sheth (1969, p.27), however, classified repetitive decision making into three stages: (1) extensive problem solving, (2) limited problem solving, and (3) routinised response behaviour. Extensive problem solving refers to situations in which the doctor has not yet developed well-defined and structured choice criteria. Limited problem solving is required when the choice criteria are structured but where a strong preference for a single brand is absent. Routinised behaviour occurs when the choice criteria are well defined and structured and the doctor has a high predisposition toward one or two brands.

Prescription serves psychological and social needs of GPs such as earning approval for giving good patient care (Haayer 1982, p.2022). Therefore, the decision to prescribe a drug requires a high involvement on the part of the doctor. The risk involved and the dependency of a GP's reputation on making correct decisions explain this assumption.

However, there are cases, especially with a low degree of risk involved, in which limited problem solving or even routinised prescription behaviour can be assumed. In order to include the most complex decision situation the process of high-involvement with extensive problem solving is described.

In the absence of a definite empirical verification, buyer behaviour is best described using a model. As with all models, an attempt is being made to explain a process and to specify relationships.

Several models of buyer behaviour have been developed. These include the Howard and Sheth models (1969, 1974), the Howard model (1977), and the models introduced by Engel, Kollat and Blackwell (1968, 1973, 1978), and later by Engel and Blackwell (1982).

The Engel and Blackwell model has its emphasis on the process of decision making. Since the objective here is to describe the process of prescribing, with the view to understanding the likely impact of the elements of the communication mix discussed in section 3.4, the

Engel and Blackwell model is chosen to illustrate the prescribing process.

Of interest here is the model for high-involvement processes (figure 3.3) considering the considerable risks involved in prescribing ethical drugs. This approach seems reasonable, although work by Stern (1987) might indicate a lower involvement of the doctor than anticipated or even be required.

The process of drug prescription will be explained using the model as a guideline.

a) Problem recognition

In contrast to consumer markets in the GP-market, problem recognition is not triggered by a stimulus related to the decision maker, but rather by an outside stimulus - the appearance of a patient with certain symptoms. Recognition of the problem takes place once the doctor examines the patient. The doctor's perception of a difference between an ideal state and the actual state of the patient's health triggers the recognition of a problem. It is obvious that a certain level of severeness in the perceived difference must have been passed before an actual treatment is indicated. This threshold effect will vary with the kind of illness.

b) Search

Assuming a decision to prescribe has been made, the doctor now turns to the decision on the kind of drug to prescribe. Following a search within memory a decision might be made immediately. This is the case when a certain brand is preferred over others based on past experience. Then routinised behaviour can be observed.

In case the internal search does not lead to an immediate decision, the doctor will turn to an external search, making use of a variety of information sources.

The search process is primarily influenced by memory and beliefs. Memory is influenced by a string of events. Starting with some sort of "stimulus", the process is triggered. Stimuli are partly in control of the marketing manager by means of advertising, conferences or sales calls for example. The process could also be triggered by a colleague's comment.

The first step is the exposure of the doctor to the stimulus. Preliminary information processing takes place. A certain degree of attention, allocation of information processing capacity to the incoming stimuli, is attracted. Comprehension refers to the short term memory where the meaning of the content is clarified. Due to the limited capacity of short term memory the information process is highly selective.

Once the stimulus is comprehended the meaning is compared with existing beliefs which are stored in long-term memory. If there is compatibility with existing beliefs these will be reinforced or changed and the message retained in long term memory.

c) Alternative Evaluation

Once the search has been completed, the choices need to be evaluated. A comparison with the evaluative criteria takes place. The outcome of this assessment is the formation of beliefs. This refers to a doctor's perception of the various choices compared with his standards. This in turn influences the attitude toward a product. An attitude is used here as the positive or negative evaluation of the prescription of a particular product. In case of a favourable attitude the next step involves the intention to prescribe the product in question.

The relationship between changes in attitude and changes in behaviour leaves room for debate. Fishbein (1967) concluded that there is little evidence supporting the hypothesis that knowledge of an individual's attitude towards some object will allow one to predict his behaviour with respect to that object. Engel and Blackwell (1982), however, distinguished between low and high involvement decision processes. For low involvement processes they concluded that a behavioural act is undertaken followed by a change in beliefs. In high involvement processes, however, they observed an affection of the cognitive structure by new information due to the extended problem solving. Thus, changes in beliefs and attitudes occur, followed by a change in behaviour.

There are arguments for both viewpoints. The implication of this discussion is most important for promotional decisions. If there was no direct relationship between a change in attitude and behaviour, spending on promotions would be a needless waste.

d) Choice

In the model choice is the outcome of intentions and unanticipated circumstances. Unanticipated circumstances do not play as major a role in the GP market as in other markets. Due to the pattern in the prescription market, common circumstances can not occur. Those include a momentary lack of funds, out-of-stock situations and the influences of exposure to other brands at the moment of decision making. Therefore, intention is the crucial step in the decision process. Intention is not only influenced by beliefs and attitudes as explained above, but also by a GP's degree of compliance to norms and informational influence. Norms have a strong impact on the decision making process, since the GP has to make the decision in the light of the search for a superior medicine in order to cure the patient but needs also to take into account the expectations and codes of conduct of the National Health System. Other sources of influence are the opinions of colleagues in the community or in the special area of interest.

e) Outcomes

In terms of the model used, the choice of a product can result in either satisfaction or dissonance. Either outcome has a strong influence on future prescription behaviour.

Satisfaction, defined as an evaluation that the chosen alternative is consistent with prior beliefs with respect to that alternative (Engel and Blackwell 1982, p.501), will reinforce beliefs about a product and thus, will strengthen brand loyalty. In the case of dissatisfaction the opposite behaviour can be observed.

Dissonance, however, occurs when cognition or beliefs do not fit together. Then the decision maker tries to resolve the post-choice doubts. Dissonance can be reduced by a re-evaluation of choices, leading to either an increased perception of the attractiveness of the selected choice and/or a downgrading of the option not chosen.

On the other hand, dissonance can lead to a post-decision search of information, in order to confirm the wisdom of the choice.

3.3.2 Diffusion.

In the preceding section the prescription process has been examined at a constant point in time. Now, the emphasis is on changes in prescription behaviour over time, looking at dynamic effects. This approach leads to an overview of research into diffusion processes which examine product adoption issues.

Clearly, the decision process varies with the stage of the product life cycle and with the characteristics of the doctor, namely with his degree of innovativeness. These two aspects will be dealt with in this section.

The dynamic, perspective pursued in this section leads to the emphasis on the process of adoption of a drug that has recently become available in a market. This broad definition of an innovation includes newly developed products as well as existing drugs launched in a new market segment.

The traditional model of the adoption process consisted of five stages (Rogers and Shoemaker 1971, p.100):

1. Awareness; the individual learns of the existence of the new idea but lacks information about it.

2. Interest in the innovation is developed and additional information is sought.

3. Evaluation; mental application of the new idea to his present and anticipated future situation and decision whether or not to try it.

4. Trial; application of the new idea on a small scale to determine its utility in the present situation.

5. Adoption; continuous use on a full scale.

This model has several weaknesses in that it implies that adoption is inevitable and it also does not allow for a rejection. Additionally, the order of the stages is too rigid to suit all cases and the model does not allow for skipping of some stages or even an iterative nature of the diffusion process.

Consequently, Rogers (1983) introduced a new model taking the deficiency of the previous model into account. Again five stages were distinguished: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, (5) confirmation.

This model will be described using figure 3.4 as an explanation of the inter-dependencies.

(1) Knowledge.

Knowledge refers to the individual's exposure to the innovation and the gain of some understanding of how it functions. An interesting aspect is the relationship between needs and knowledge. Do needs lead to knowledge or vice versa, does knowledge lead to a perception of a need? For a new medical drug Coleman et al (1966, p.59) found that initial knowledge about the product occurred due to a doctor's exposure to various communication channels, such as colleagues or industry sources. They concluded that only in the later stages of the innovation decision process did the doctors turn into active information seekers.

The process may stop after the stage of knowledge depending on a doctor's attitude towards the innovation. If the information is perceived to be irrelevant to his or her situation no adoption will be achieved.

(2) Persuasion stage.

At this stage the individual becomes more psychologically involved with active information seeking as a consequence. Important influences for the decision process include the place where the information is sought, the kind of messages received, and the interpretation of the information.

(3) Decision Stage.

At this stage the individual decides to either reject or to adopt the innovation. An important means of coping with the uncertainty of the decision is a trial of the innovation on a small scale. Klonglan (1962 and 1963) found evidence that a free trial speeded up the decision period by about a year when he examined the adoption process of a new weed spray among Iowa farmers. This finding underlines the importance of samples in the GP market.

Rejection can occur when a prior decision to adopt is altered (discontinuance) or in a continued rejection.

(4) Implementation.

When the innovation is put into use, the implementation stage is reached. The implementation requires a change in behaviour. Still a certain degree of uncertainty exists. Therefore, the role of a change agent is important in providing assistance in the active information search by the individual.

Once the innovation becomes an institutionalized part of the individual's operations the implementation stage is completed.

(5) Confirmation Stage.

Reinforcement is sought after the adoption decision has been made. Conflicting messages may lead to a perception of dissonance, which in turn can lead to the reversal of the adoption decision. Re-evaluation and/or a further information search might be the consequence.

The rate of adoption varies among members of a population. This section describes the different categories into which innovativeness, the degree to which an individual is relatively early in adopting new ideas than other members of a system, can be classified.

Rogers (1983, p.243) showed that the adoption of an innovation generally follows a normal, bell-shaped curve when plotted over time on a frequency basis. Using the mean and standard deviation the normal adapter distribution is divided into categories. Rogers (1983, p.246) described as categories the first 2.5 percent as innovators, the next 13.5 percent as early adopters, followed by 34 percent early majority. The 34 percent between the mean and one standard deviation are called late majority. while the laggards account for the last 16 percent.

These categories describe ideal types. The characteristics of the members of each category will be outlined very briefly.

The key characteristic of innovators is called 'venturesomeness'. The individual desires the risky and hazardous and is eager to try new ideas. The social relationships are cosmopolitan, but innovators might not be respected by other members of the system mainly because their activity leads to change and instability.

Early adopters have the highest degree of opinion leadership in most systems because they are an integrated part of the local social system. By carefully assessing the value of an innovation and the subsequent adoption they earn the respect of their colleagues by decreasing uncertainty for them.

The category early majority describes those who adopt just before the average member of the system. The latter deliberate for a long time and thus, seldom hold leadership positions, but have frequent contact with their peers.

The late majority's approach to innovation might be described as sceptical. Due to economic necessities or group pressures they are forced to adopt.

The last to adopt an innovation are the laggards. With their traditional values and limited resources they only adopt when it is very safe to do so. They tend to be resistant to change and isolated in social networks.

In summary, the innovators and early adopters have a very strong influence on the success or failure of an innovation (Gunston 1984, p.620). From the marketing point of view it is important to adjust the marketing strategy in order to take the findings just described into account. The implications for the marketing strategy are that initially the innovators need to be targeted, while after a few weeks the focus should turn to the early adopters. Once the early majority is covered, the return to normal coverage is advised, using word of mouth within the medical community to transmit the message (Flaum 1982).

This approach is sound, but its application requires the identification of members in each category. The problem in particular is to pinpoint the innovators and early adopters. For example, in a complex study Coleman et al (1966, p.157) established the description of innovators and early adopters in the GP market. This group of GPs consisted of high prescribers of drugs for whom the image of a company plays an important role in their decisions.

The implication for the marketing of pharmaceuticals is the need to differentiate a product by using a brandname, unique package, or product offer.

3.4 Communication in the Industry

The pattern of the ethical pharmaceutical market requires the application of certain tools to communicate with the general practitioner. The role of the detailer (representatives), of advertising and of sales promotion is briefly discussed in this section.

3.4.1 Detailer

In order to contact the GPs in the UK personally, approximately 50 sales representatives are required. Slatter (1977, p.30) has defined the task of a detailer as:

> To promote the use of and to sell ethical drugs and other pharmaceutical products to physicians, dentists, hospitals and wholesale drug establishments, utilising knowledge of medical practices, drugs and medicines. Inform customers of new drugs, explain characteristics and clinical studies conducted with drugs. Discuss dosage, use and effect of new drugs and medical preparations.

Consequently the following functions need to be performed (Slatter 1977, p.39) by:

- Selling, by persuading doctors to write prescriptions for their firm's products.

- Providing information to doctors concerning new products and new developments relating to existing products.

- Distributing samples and product literature to doctors.

- Providing the company with information relating to side-effects discovered by prescribing doctors.

- Arranging clinical trials and clinical research as appropriate.

- Transferring the experiences of one doctor to others.

Solc (1980, p.202-203) additionally stressed the representative's role as a source of information. Knowledge gained about competition and doctor's reaction can lead to an adjustment of the marketing mix.

During a sales call the detailer has to take into account that the decision making unit quite often not only consists of the doctor himself, but also of nurses and receptionists. A favourable attitude of this group can enhance the acceptance of a company's products.

While Solc (1980, p.202) pointed out that the emphasis in Germany and Switzerland is on the detailer's calling on doctors, Slatter (1977, p.30) described the importance of calling on pharmacists and wholesalers additionally, in order to ensure distribution. Depending on a company's involvement in the market of OTC-products and their general strategy a second sales force is employed.

In 1983, 28,660 GPs and 16,190 dentists were registered (Social Trends 1985, p.115). For eight GPs there is one medical representative in the UK (Bennet 1984). This ratio is similar to the situation in France, where a total of 8,000 detailers are expected to call on 56,000 doctors (Bon, Michon and Olivier 1985, p.52). Taking into account a daily call rate of nine (Apfelbaum 1985, p.45), it is obvious that the detailers are kept busy by just calling on doctors, let alone calling on hospitals.

3.4.2 Advertising

The objective of advertising ethical pharmaceuticals is no different from advertising any other product - namely to produce awareness that will favourably motivate the subject to utilise (prescribe) the product (Ferm 1975, p.292).

The target audience for ethical pharmaceuticals is doctors. It is uncommon, and in most countries restricted by law, to advertise drugs to the general public (Brownlee 1979, p.218). Some international companies advertise just in order to gain some public relation effects.

Journal advertising can reach numerous members of a target group at relatively low cost. The placement of advertisements in journals and magazines published especially for medical professions is particularly pursued by smaller companies. Thus, the reputation of a company can be enhanced and the increased awareness can support the detailer's sales call.

Direct mail offers the opportunity to channel the message to specific individuals rather than to a group. Promotional techniques are applicable that are not readily available in journal advertising. For example, product requests from the physician can be obtained in the form of self-addressed business reply cards included with direct mail promotional material. This technique establishes a measurable relationship between manufacturer and physician. (Ferm 1975, p.303).

The drawback with direct mail is that it has been used quite excessively in recent years, making it increasingly difficult to obtain the doctor's attention. To overcome the problem of over exposure to direct mail, Ferm (1975, p.303) suggests the development of a manufacturer sponsored journal or a 'house organ'. The effectiveness can be questioned, since the doctor is confronted with enough journals anyway.

3.4.3 <u>Sales Promotion</u>

Sales promotion is defined as "all forms of clearly sponsored communication other than advertising and selling" (Ray 1982, p.14). Because of the structure in the market for ethical pharmaceuticals outlined above, these will hardly be forms of sales promotion that are common in other markets. For example, price-off packages, a common tool in consumer marketing, are of no value in this market.

Three aspects of sales promotion are demonstrated in this section: samples, visual aids and medical exhibits.

a) Sampling.

There is no better way of demonstrating the effectiveness of a drug than by the actual use. Samples are an important tool in overcoming the initial resistance towards a new product. For well established products there is obviously no need for support by samples. However, the mis-use of this technique has led to public pressure in order to restrict sampling (Smith 1975, p.329).

b) Visual Aids.

Sales assistance is also given by the use of aids especially designed for the sales presentation, such as folders containing product information. Various tools are to be left with the doctor as a reminder. These "give-aways" are widely accepted in the industry. The items may range from books of matches to useful medical equipment, depending on the creativity of the marketing department.

c) Medical exhibits.

Attendance at a medical exhibition offers the opportunity to discuss the features of a product in a more relaxed atmosphere than it is the case in the GP's practice. This has led to an increase in the number of industry sponsored conventions so that it is increasingly difficult to get the target audience interested in a certain event. The organizers have to differentiate in order to attract attention.

3.4.4 New forms of communication

In a recent study it emerged that just seventeen percent of a detailer's time is spent on actually talking to the doctor, the rest was spent on various other activities, such as travelling (Apfelbaum 1985, p.45). Therefore, new forms of communication have been sought (Bon, Michon and Ollivier 1983, p.55).

Communication via telephone for example is becoming increasingly important, as well as product information on video cassettes. Future developments might include the use of systems like Prestel in the UK or BTX in Germany (Brasser 1985, p.60; Viehues et al 1985, p.65; Schultze 1985, p.68).

Meditel provides approximately 6,600 doctors within the NHS with news. The service is sponsored by advertising from the industry. Treatment viewdata is a commercially operated information service providing information about side effects, prices, etc. (Pfaff 1985, p.1765).

The utilization of these new techniques is enhanced by the increasing use of micro-computers in practices.

The breakdown of pharmaceutical promotion expenditure shown in figure 3.5 (ABPI 1985a, p.32) indicates that sales representatives account for approximately forty-five percent of the total expenditure in the ethical pharmaceutical industry in the UK. This has not changed very significantly over the last fifteen years. The changes concerning the limited list might lead to a shift in the importance of the different elements. When an increasingly more generic prescription is required, then there will be no need to promote a certain brand. Consequently, cuts in the size of the sales force seem to be inevitable.

3.4.5 Effectiveness of the Communication Mix

Numerous studies have been conducted aimed at the detection of influences in the prescription process. An overview is provided by Reichwald-Dietzsch (1981a, 1981b). The focus of each study differs widely from others. No attempt is made here to structure the findings, it is intended only to highlight a few important findings.

In a review of the literature Hemminki (1975) pointed out the importance of education, advertising and colleagues. She found that the studies reviewed suggested that doctors' education positively influences the quality of prescribing. This finding was confirmed by Klein et al (1981).

Joyce (1970) found that GPs with higher education were associated with less prescribing of drugs of all kinds. On the other hand in England no significant difference in prescription patterns among doctors graduating from different medical schools could be established (Lee, Draper and Weatherall 1965). However, this study was conducted before the impact of the 'new' Universities could be tested.

Hemminki (1975) pointed out yet another problem area in that the life of a drug often only covers a time span of approximately five years. This indicates that the initial education for a doctor can only have a limited influence on the prescription pattern.

Williamson (1975, p.233) contended that doctors in group practices are more likely to rely on their colleagues' opinion while solo practitioners use literature and commercial sources. Peay and Peay (1984), however, could not establish a significant difference between the two.

Haayer (1982) found that rational prescription was related to physician rather than patient characteristics. The younger GPs tended to be more rational. However, Epstein et al (1984) concluded that doctors' attitudes to factors such as effectiveness, side effects, likelihood of compliance, cost and the patient's perception of the doctor may influence the drug choice.

Hartsema and Christensen (1983) found that older GPs tend to have older patients. This implies that the GP's age does not explain higher prescription rates but functions as a proxy for older panels of patients who in turn have more chronic illnesses and hence need more drugs.

Demographic discriminators were also found to be of value to explain prescribing behaviour. Jones et al (1980) detected a higher prescribing rate in Wales compared with England.

Overall, Bush et al (1984) found family doctors in the US to be conservative prescribers, particularly in the case of hypnotics. Although Rosser (1983) detected a significant difference between actual and perceived rate of prescribing Diazepam, a tranquiliser.

In the category of tranquilisers Chambers et al (1983) concluded that more drugs in this class were prescribed by:

- GPs rather than specialists
- GPs in solo practices

- GPs who see a high number of patients
- GPs who have been longer out of medical school.

In the UK a favourable attitude towards industry supplied information was detected (Mil Research 1980). However, medical professionals expressed their concern about the total level of promotional activities which was considered as being excessive (Milpro 1985, p.5).

On the other hand, a doctor's attitude towards a source does not necessarily reflect its importance. Avorn et al (1972) found a discrepancy in doctors' perception of the influence of advertising and detailer and the actual effectiveness of these sources. As reasons they quoted either the doctors' unwillingness to admit reliance upon commercial sources or their lack of awareness of such influence.

In another study (ABPI 1975) it emerged that solo practitioners and older GPs tended to have a more favourable opinion of the detailer. It was found that representatives were regarded as the most important sources for information followed by medical journal articles. In this study it appeared that the least important communication media were mailings and advertisements. This attitude, however, mirrors only the perception. On the other hand, Segal and Hepler

(1982) found that face to face consultation may be a more effective method of influencing prescribing than other methods of communication.

The importance of the source of information varies clearly with different stages in the diffusion process. Mapes (1977, p.620) suggested that "innovatory prescribing must proceed as something of an act of faith". Peay and Peay (1984) found that commercial sources play an important role at the first stage of the adoption process, while colleagues play a minor role. These findings are not in line with those by Coleman et al (1966), who concluded that colleagues serve a legitimising function in drug adoption.

The results of the various studies just outlined need to be related to how pharmaceutical companies can increase the effectiveness in communicating with doctors. This needs to be seen in the light of the aspects discussed in this section, namely buying behaviour and the diffusion process. Figure 3.6 depicts how Solc (1980, p.191) summarised the value of the different communication tools in the various stages of the diffusion process. His findings stress the role of the detailer in creating awareness and interest, while the important influence of colleagues in the actual decision to adopt is stressed.

3.5 The Company and its Problem

The previous sections in this chapter have described the environment in which pharmaceutical companies operate in the Uk, have looked at prescribing behaviour, and have analysed the effectiveness of the communication mix available to pharmaceutical companies. This information forms the background to the case example which is explained in this section.

The case example underlying this work is based on the situation of an American ethical drug manufacturer (hence called the Company) operating in the UK Market. The Company is operating in six therapeutical classes. Thus, based on turnover, it is among the top fifty drug companies in the UK. On a worldwide bases the company is among the largest fifteen companies.

As explained in the previous sections, the sales force is the dominant communication tool for this company. Just below fifty detailers are employed on a full-time basis, covering the entire UK area.

Changes in the PPRS had the effect that the company suddenly operated very much at the limit of the promotional expenditure allowance. However, it was just large enough not to suffer any immediate reductions, the company could still maintain the entire sales force.

The introduction of the limited list, however, had two major effects. Firstly, the most successful drug in the product portfolio, a tranquiliser was affected by the rule of generic prescribing in that therapeutic class. At the time of the introduction of the limited list, however, this drug was still under patent protection (to remain so for another two years). This change meant, that doctors had to prescribe by generic name and were not allowed to prescribe by brand name any more. Due to the patent protection the only drug available under the generic name was the company's brand Halcion. Thus, in their communication with doctors, the company only had to stress that the drug was still available under the NHS system but had to promote the generic name. Subsequently, sales suffered only marginally.

The second effect of the introduction of the limited list had much more impact. The second drug in question was taken off the list of re-imbursable medicine completely. The drug affected was a relatively new product which had been launched very successfully just before the introduction of the limited list. Strategically it had just turned into a 'Star' product with all the prospects of becoming the company's major cash generator in time to replace the other drug mentioned previously.

This development had an immediate impact on the role of the sales force. For the new product it would have been perfectly adequate to use the sales force to reinforce its 'Star' position. Starved of this product, the company was left with mainly mature products, of which most had reached their respective potential. Therefore the strategic question was, what to do with the sales force and how to employ it as effectively as possible. In the light of the PPRS changes this also included the question whether to maintain a sales force at all. In the light of expected new product developments in the medium term it was decided to keep the sales force but to examine its most effective use.

3.6 The Data

At this stage the company was introduced to market research data compiled by Medical Direct Mail Organisation (MDMO). The objective for MDMO is to supply pharmaceutical companies with detailed information on individual General Practitioners. This information is then directly translated into a call card system. An example of a call card is displayed in figure 3.7. Thus, the individual sales representative in a company is provided with a fairly detailed profile of a doctor. Combined with the representative's personal knowledge the call card provides a good preparation for the sales call.

But it is not only of benefit at the sales call level. From a marketing point of view the call card system offers the chance for proper targeting. Searching for certain key information, i.e. number of patients, number of prescriptions in a therapeutic class, subsets of the whole GP population can be found. This subset can then be targeted for a special promotional activity carried out either by the sales force and/or by direct mail.

When the company adopted the call card system, data on 19,000 GPs were available. The number has increased to more than 21,000 in the meantime. Tests for bias in this sample carried out by MDMO revealed the representativeness of the doctors included in the database. Without having access to the full database it is obviously difficult to substantiate this claim. Since no adverse comments were received from practitioners in the industry, one can assume that the effect of the bias is not that dominant. However, incomplete information on another 3,000 doctors is available, so that the whole database covers approximately 80% of the GP population.

The information is obtained based upon a questionnaire as shown in appendix 1 . The GPs participating are aware of the commercial application of the database. As an incentive for participation a nominal sum is paid to charity for each completed questionnaire. For this study two samples of 1000 doctors from the MDMO database were selected. The first sample is used to carry out the analyses, the second sample functions as a hold-out sample to validate the findings.

The criterion for selection of the two samples was that the doctor responded to the questionnaire twice. The first time during the period January-April 1984 in the first mail shot and a second time during March-May 1985 when the first update was conducted. Each sample was then constructed to be representative of the MDMO data set. This means that it was representative of the distribution of demographic information as well as of the information on brand preference.

Thus there is a bias in the samples towards more responsive doctors, reflected in the criterion of having responded to the questionnaire twice. Apart from that particular bias care has been taken to create samples as representative of the total MDMO sample as possible, thus as representative as possible of the entire GP population.

Using this procedure four sets of samples were available for analysis. Two sets of 1,000 doctors each covering 1984 and two sets of the same 1000 doctors each covering 1985. The reason for splitting the 2,000 responses at each point in time into two sets is to use one set to develop the necessary analysis and use the second sets as a hold-out sample to validate the findings.

3.7 Summary

The market for ethical pharmaceuticals in Britain is dominated by the largest customer, the National Health Service. Consequently, the Government is not only restricting the market for safety reasons but also in its own interest, on financial grounds.

In respect of the latter the frequent updating of the re-imbursable list of drugs and price negotiations with the manufacturers are supposed to lead to a moderate increase in the total cost of the health system to the taxpayer. Unlike in other industries profits are restricted to a rate of currently twenty one percent of sales. This rate is fixed in the Pharmaceutical Price and Regulation Scheme in which marketing expenditure is limited to nine percent of sales for an individual company.

Within this frame companies need to target their marketing efforts towards medical doctors, general practitioners in particular. They are at the centre of the complex relationship between NHS, industry and patients. In contrast to other markets the individual who makes the buying decision is not receiving the product and neither is he/she paying for it.

This specific market situation calls for the application of certain marketing tools. The most important element in the communication mix is the sales force. Journal advertising, direct mail and other forms of sales promotion play a relatively minor role.

The case example introduced in this chapter has highlighted the problem of a smaller pharmaceutical Company competing in the market following changes in the PPRS and the introduction of the limited list. Torn between the need to maintain national coverage by the sales force, restricted by limited expenditure allowed, and the drop of a 'Star' product from the list of re-imbursable products, the Company was forced to target its sales force activities more effectively. Many, especially smaller, companies in the pharmaceutical industry faced a similar problem.

The advent of new market research information therefore fulfilled an apparent need of companies. The STARS database assists, via the call card system, the sales force at the level of the individual doctor. It also allows at the managerial level the fine-tuning of marketing activities by targeting specific doctors with promotional activities via the sales force or direct mail.

The successful implementation of the STARS database enhanced managers' belief in more scientific approaches to managerial problems. Thus, the ground was well prepared when the researchers presented the idea of taking the targeting effort and sales force allocation problems one step further by using the available information to segment the market and to tackle the resource, sales force in particular, allocation problems.

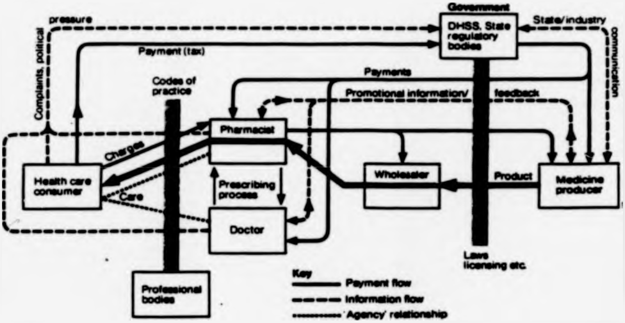
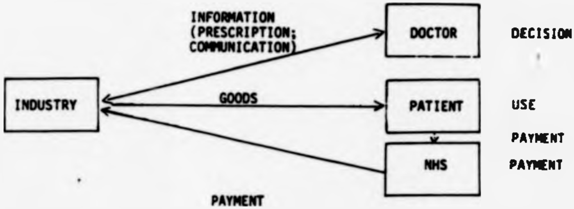
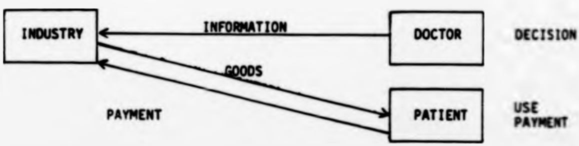


Figure 3.1 The prescription market in the UK (Taylor, 1983)

a) OTC - Market



b) NHS - Market



c) PRIVATE PRESCRIPTION MARKET

Figure 3.2 Pattern in the ethical drug market
(adopted from Solc, 1980)

INDUSTRIAL MARKETS	CONSUMER MARKETS	
	a) High involvement	b) Low involvement
1. Anticipation or recognition of a problem (need)	1. Problem recognition	1. Problem recognition
2. Determination of characteristics and quantity of needed item	2. Search	2. Evaluation of choices
3. Search for and quantification of potential sources	3. Evaluation of choices	3. Selection
4. Acquisition and analysis of proposals	4. Selection	4. Outcome
5. Evaluation of proposals and selection of suppliers	5. Outcome	
6. Selection of an order routine		
7. Performance feedback and evaluation		

Figure 3.3 Comparison of decision processes in industrial and consumer markets (partly adopted from Engel and Blackwell 1982)

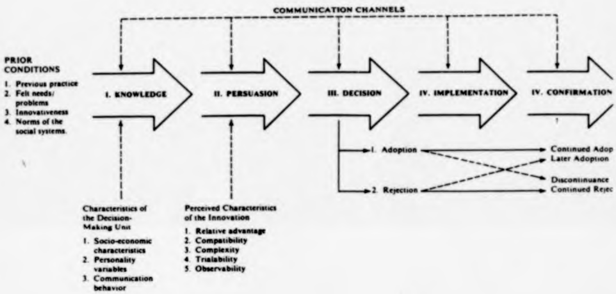


Figure 3.4 Stages in the adoption process (Rogers, 1983)

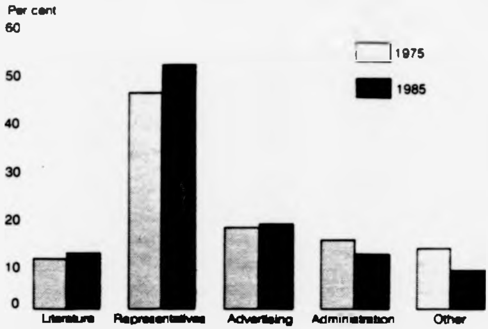


Figure 3.5 Breakdown of promotional expenditure (ABPI, 1988)

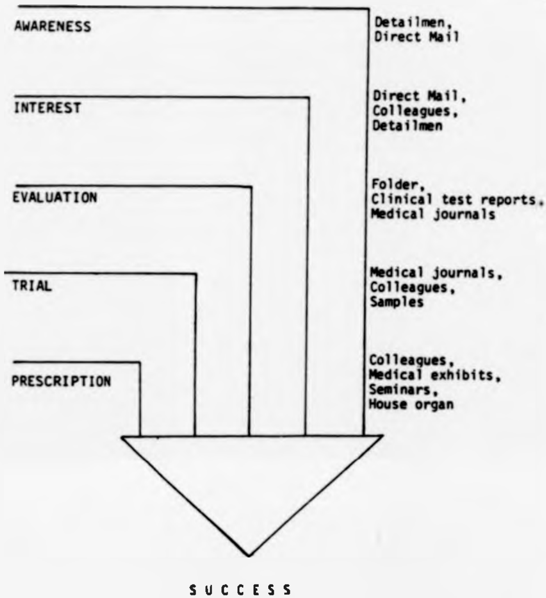


Figure 3.6 Sources of information at different stages in the prescribing process
(Solc, 1980)

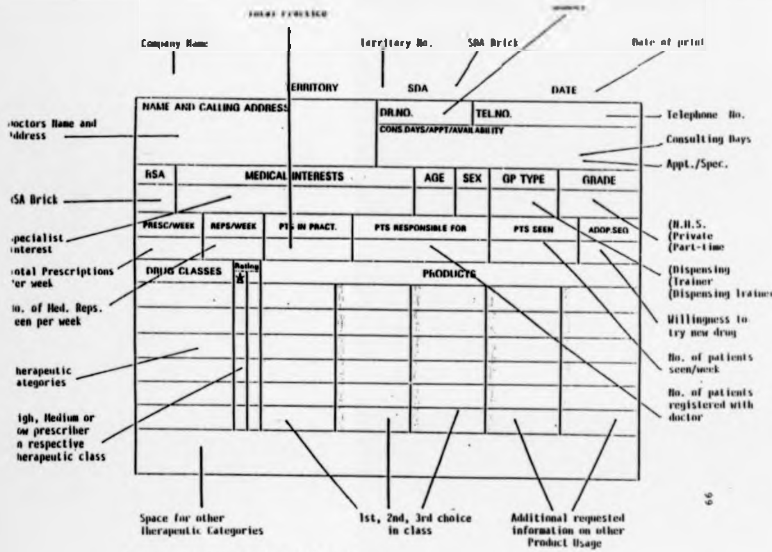


Figure 3.7 Example of a call card

Chapter 4 MARKET SEGMENTATION

4.1 Introduction

The previous chapter outlined the important role of the sales force in pharmaceutical markets. Considering the constrained marketing budget it is obviously very important for pharmaceutical companies to allocate the scarce resource sales force and other promotional tools as effectively as possible.

One way of increasing the effectiveness of the sales force is obviously to focus on those doctors who respond best to the sales force effort. Therefore, this thesis sets out to test whether segmentation can be used to allocate sales effort and whether such a segmentation procedure can be implemented in practice.

In order to allow the test of these hypotheses this chapter provides a literature review on segmentation research.

Amendments in the regulations of the NHS have led to a change of the pattern in the GP-market as described in the previous chapter. In order to adjust to this new pattern and to obtain a competitive edge, the marketing strategy for the company will need to be redeveloped.

The different steps in the development of a marketing strategy are described in a model introduced by Doyle and Saunders (1985) as demonstrated in figure 1.1. They point out the key role of market segmentation. Target markets should only be identified after the determination of market segments and an assessment of their attractiveness. Only then any decisions on resource allocation should be made. Consequently, this chapter is concerned with the review of the relevant literature on segmentation.

The GP market, as described in chapter three, is different to any other market. With the complex buying process involving users (patients), deciders (GPs), and influencers (NHS), it is very much an industrial market. With the key person being an individual doctor, however, similarities to consumer markets should not be overlooked. Hence, it is planned to identify approaches in consumer and industrial market segmentation research which are useful for a thorough approach to the segmentation of the GP-market.

To achieve this objective the following steps are undertaken. Firstly a brief description of the segmentation theory and its implementation will be provided, and secondly, bases for segmentation in consumer and industrial markets will be evaluated.

4.1.1 Market Segmentation defined

It has been acknowledged that the term "segmentation" was first introduced by Smith (1956). He defined it as a concept of "viewing a heterogeneous market as a number of smaller homogeneous markets in response to differing product preferences among important market segments" (Smith 1956, p.3).

According to another view (Choffray and Lilien 1980, p.78)

> "market segmentation is concerned with grouping potential customers into sets that are homogeneous in response to some elements of the marketing mix."

Both definitions take into account that real markets are not homogeneous and that customers are different. Segmentation leads to the identification of customers' needs and thus enables a company to direct its efforts to satisfy those needs.

As early as in 1934 Frederick suggested dividing an industrial market into its component parts. He thought that five factors needed to be considered: industry, product use, company buying habits, channel of distribution, and geographic location.

During and after the Second World War, companies concentrated on the improvement of production facilities in order to meet the high demand. Consequently, mass production of undifferentiated products was the key to success. Once the initial high post-war demand was satisfied, companies no longer succeeded in providing undifferentiated products. Customers developed individual needs, the emphasis shifted from production orientation towards marketing orientation in order to satisfy the identified needs. In this period the theory of market segmentation was developed.

The purpose of market segmentation is the identification of segments permitting the development of marketing strategies in order to satisfy specific needs and wants. It is clearly the objective to put the company in a more beneficial position, mainly to achieve increased profits. Thus, the incremental profits gained through segmentation need to offset the cost of segmentation (Bonoma and Shapiro 1984).

A crucial criterion for determining the desirability of segmenting a market is whether the segments have different elasticities with respect to price and promotional policies of a firm (Frank 1968).

Depending on the product/market situation, segmentation can lead to any situation between the extremes of treating each single customer as a segment, as in some industrial markets, or having a homogeneous market and, thus, a single segment.

The term segmentation in this thesis will be viewed as a strategic issue of resource allocation, rather than for measuring and statistical analysis (Johnson and Flodhammer 1980). Therefore, the decision oriented approach to the problem is accepted as opposed to a behavioural research approach which is more concerned with the identification and documentation of differences among customer groups (Frank et al 1972).

4.1.2 The Segmentation Process

After having defined the term market segmentation and a description of its advantages, the focus in this section is now on the process of segmentation. Kotler (1984, p.264) pointed out the characteristics of segments:

- Measurability, the degree to which the size and purchasing power of the segments can be measured.

- Accessibility, the degree to which the segments can be effectively reached and served.
- Substantiality, the degree to which the segments are large and/or profitable enough.
- Actionability, the degree to which effective programmes can be formulated for attracting and serving markets.

Which are the considerations to be taken into account in order to derive segments which fulfill these characteristics? To answer this question a framework for key issues in market segmentation was developed by Wind (1978). Figure 4.1 outlines the five major phases of segmentation research, namely: problem definition, research design, data collection, data analysis, and data interpretation and strategy implementation.

In a changing market environment, as in the pharmaceutical markets, managers' needs are bound to change. Therefore, the argument is in favour of an on-going segmentation. The segmentation model requires the selection of dependent and independent variables as bases or descriptors respectively (Wind 1978).

Four types of models are distinguished: a priori, clustering-based, flexible, and componential segmentation (COSEG) (Green 1977). Each model calls for a different research design before the data collection stage is reached. Analysis of the data requires the application of advanced mathematical techniques. In a joint effort the results should be interpreted, combining the researcher's statistical expertise and the manager's intimate knowledge of the market.

The framework demonstrates the importance of identifying bases for segmentation in order to pursue an a priori strategy. However, the identification of bases can also be very useful in applying the clustering approach by allowing a pre-grouping.

Johnson and Flodhammer (1980), as demonstrated in figure 4.2, proposed assessments of variables for industrial market segmentation. They used the categories (1) measurable, (2) available, (3) predictive, and (4) degree of usage to assess the usefulness and feasibility of conducting segmentation studies on certain bases.

Market segmentation has been defined, and major considerations in conducting segmentation research have been discussed. The remainder of this section is concerned with the identification of bases on which the GP market can be segmented.

The complex situation in pharmaceutical markets has been outlined in the previous chapter. In particular the GP-market with usually one decision maker but third party payment shows elements of both consumer and industrial markets. Therefore, the literature on segmentation approaches for both markets must be evaluated.

It is argued (Wind 1978) that most of the segmentation research approaches in consumer markets are equally applicable to industrial markets. However, especially the existence of a Decision Making Unit (DMU), as opposed to an individual, creates a much more complex situation in industrial markets. Consequently, in industrial markets additional considerations need to be taken into account. It is also arguable whether the same approaches can be used. For example, a segmentation based on life-style will hardly be applicable to industrial markets. Therefore, it can be concluded that a different approach to industrial market segmentation is necessary.

Green (1977) classified the different approaches using the categories a priori and post hoc. An a priori design requires the determination of a basis before the study is conducted while in a post hoc or clustering design (Wind 1978) the segments are determined on the basis of a clustering on a set of relevant variables.

Considering the objective of the literature review, this classification is not useful in our case. The approaches are classified according to each one's basis for segmentation.

4.2 Bases for Segmentation in Consumer Markets

A segmentation basis can be defined as a criterion according to which potential customers are grouped. In consumer markets, bases can be divided into the analysis of consumer characteristics and the analysis of behavioural differences (figure 4.3).

Early segmentation studies were mainly based on geographic grounds. Thus, a company selected its target markets in certain parts of the country and so avoided the service of the whole country. This is probably the easiest way to segment a market, but this approach is mainly cost driven and does not reflect a very strong marketing orientation.

The next popular category, the socio-economic and demographic basis, also offers the advantage of measurability and easy access to relevant data (Frank 1968).

Relevant in this category are bases like age, sex and education. It can be assumed that there is a relationship between prescribing habit and age (year of graduation respectively). Sex as a basis is probably the weakest of the three mentioned but still might explain a different behaviour, especially for female/male complaints.

An important basis needs to be added to this general list; whether or not the doctor is a member of a group practice can have a significant influence on his/her prescribing habit.

Another dimension of consumer characteristics includes psychographic bases. The development of life-style segmentation intended to go beyond the information provided by demographic data. Thus, a "humanized portrait" (Wells 1974) of the customer group is drawn by focusing on specific attitudes (beliefs, values, interests, and intentions) and activities (Hustad and Pessemier 1974). This approach is sensible, since the probability that two people pursuing the same life-style behave similarly is higher than that of two people of the same age.

However, there is the difficulty of measurement to overcome. In this particular case it is very difficult to use this as a basis for segmentation due to the lack of information. The questionnaire on which the data are based in the case described here does not include relevant questions to allow a segmentation on life style.

Usually none of the various bases described is sufficient enough by itself (Frank, Massy and Wind 1972). Consequently, complex segmentation models incorporate a number of bases as variables.

Various studies (Frank 1968) indicate that general consumer characteristics are not an exact basis for segmentation. The crucial step in applying the bases described is the conclusion drawn from membership of a certain group to an expected behaviour. This is the best argument in favour of using bases derived from the analysis of consumer response. Here the prediction of a certain behaviour is based upon the analysis of previous response.

Subjective measures of consumer response measure the consumer's perceptions, while objective measures are based upon post sales data.

A new dimension to segmentation research was introduced when first Yankelovitch (1964) questioned the use of demographic information and pointed out the importance of customers' values as a basis for segmentation and when later Haley (1968) introduced the concept of benefit segmentation.

Haley's approach identified market segments by causal factors rather than descriptive ones. The segments are identified on the basis of benefits being sought. This approach is based upon the ability to measure in detail customers' value systems combined with customers' attitude towards other brands in the same product category. This technique calls for the application of advanced multivariate statistical techniques. The application of which imposed a bigger problem at the time the concept was introduced compared with today's situation with increased computer power and techniques.

In the underlying problem, information on GP's preference for different products in product classes is provided. Based on the attitude or the preference, a market segmentation analysis could be conducted in applying a similar concept as benefit segmentation.

Objective measures of consumer response cover aspects of product usage. One basis for segmentation is the extent of usage. In the 1960s, quite a few studies were conducted which examined the results of segmentation along this dimension. For example, in the beer market companies identified the "heavy half" (Twedt 1961). It was detected that a few percent of the total market population accounted for the majority of the consumption. Targeting this particular group of customers required fewer resources and provided higher sales than targeting the other half.

The data provided for this study allows the identification of heavy users in the pharmaceutical market.

In addition the response to promotional activities such as direct mail could be used to identify those who are more likely to react positively to subsequent promotional activities. This basis can also be called "deal proneness".

Frank (1968) noted that brand loyalty is a real phenomenon but that the identification of a "brand loyal" customer is very difficult.

4.3. Bases for Segmentation in Industrial Markets

To some extent bases for segmentation in consumer markets can be applied to industrial markets as well. However, the emphasis in this section is on specific bases for industrial market segmentation. The second section briefly covers aspects of normative approaches to industrial market segmentation.

4.3.1 Specific Bases

Specific bases for segmentation of industrial markets are illustrated in figure 4.4. The bases are grouped along five dimensions: organisation, DMU, individual, product, and behavioural differences.

Industrial markets have for long been a somewhat neglected area of market segmentation (Bonoma and Shapiro 1984). Early approaches (Frederick 1934, Hummel 1954 and 1960) examined opportunities to segment on the level of the buying organisation. General characteristics such as industry type (SIC class) or demographic data were chosen. Applicable to the case reported here is the idea to distinguish between group and single practices, or to take geographical differences into account.

The next dimension for segmentation is concerned with the DMU. Here the position within the organisation, the composition (users, deciders, influencers, size) and the decision rules provide a basis. Since a similar situation will only be found in group practices, the DMU concept is clearly not applicable to a single doctor, this dimension is of limited value to the problem described here. Nevertheless, for group practices the composition of the DMU and decision rules could provide a basis for segmentation.

On an individual level, similar approaches as in consumer markets can be used. An interesting additional aspect is the basis "organisational role". In a group practice, those individuals need to be identified whose task it is to communicate with the industry, and who might, subsequently, act as opinion leaders.

Using the dimension 'product', an interesting basis is provided by the end use of the product. The same product could be used for the treatment of different illnesses, hence enabling the identification of different segments.

In the questionnaire, on which the GP data are based, products are already allocated to product classes, leaving the respondent very little room for individual alteration. Consequently, this aspect of segmentation is not feasible.

Cost factors are of minor importance thus, the concept of "economic value to the customer" (Forbis and Mehta 1981) is not applicable to the GP market.

Since information on the extent of product use is available, an important classification could be along the aspect of quantity, corresponding to the identification of the "heavy half" discussed in consumer markets.

The most valuable approaches are listed under the heading "behavioural differences" which cover situational differences as well. Robinson et al (1967) developed the concept of distinguishing straight re-buy, modified re-buy and new task, as different buying situations. Analysing the data available, segments could be identified consisting of users, occasional users and non-users.

The market could also be segmented using risk as a basis for segmentation. As stated in the previous chapter, GPs' prescribing habits can best be described as being risk averse. However, the perceived risk in a prescription situation will vary according to a doctor's experience and with the patient's symptoms. The degree to which a doctor is risk averse could form an interesting basis for segmentation.

4.3.2 Normative Approaches

So far different bases for segmentation in industrial markets have just been listed. It is obvious that there are interrelationships between the bases and that a single basis alone will not explain the pattern of the market. The complex situation in industrial markets therefore calls for approaches which consider the complexity. Recent developments in research have led to the emergence of normative approaches. The first normative approaches consisted basically of two steps, while more recent developments looked at integrated solutions. Thus, in the next section the two stage approaches are discussed before the new developments are evaluated in order to identify valuable approaches to the problem discussed here.

4.3.2.1 Two Stage Segmentation

The first to develop a coherent framework to evaluate different segmentation approaches were Frank, Massy and Wind (1972). They first classified on the basis of organisational differences and derive macro-segments. In the second step the market is further segmented within the macro-segments on the basis of differences within the DMU. A classification scheme values the characteristic of the situation (general or situation specific) versus the level of segmentation (divided in objective and inferred measures) and allocates the bases accordingly. They do not discuss the DMU characteristics in any detail.

Wind and Cardozo (1974) based their framework on the findings of Frank et al (1972). Following the identification of macro-segments based on key organisational characteristics they define microsegments by composition of the DMU. Their contribution lay in the provision of a framework and the extension towards a more detailed consideration of the bases used by the DMU in purchase decisions.

Choffray and Lilien (1978) followed the Wind and Cardozo framework and introduced an approach consisting of five steps:

1. Development of macro-segments of organisations.
2. Determination of the structure of DMUs in each macro-segment. Use of a decision matrix in which columns correspond to phases of the decision process and rows to buying roles of individuals.
3. Index of inter-organisational similarity.
4. Cluster analysis to develop micro segments on the basis of similarity of DMU.
5. Identification of pattern in the purchasing process within each micro segment.

They extended their work further by describing the relationship of segment descriptors and segments in an example of the cooling industry (Choffray and Lilien 1980).

Other studies used the two stage approach by introducing conjoint analysis (Wind, et al 1978) or by diffusion pattern in each segment (Wind, et al 1982). The latter approach provides a contribution to solving the problem discussed here in concluding that there are different diffusion patterns in different market segments. This could apply to different segments in the pharmaceutical industry as well.

The two stage approach is of interest to the problem in that a guidance is provided to use demographic or general information to derive at macro-segments and to use more specific data for a focus on micro-segments.

Another useful approach is the proposal by Cheron and Kleinschmidt (1985) to look for the ideal overlap of macro-segments, micro-segments and other micro-segmentation bases such as benefits sought. (figure 4.5)

4.3.2.2 Recent Developments

Shapiro and Bonoma (1983) developed the Wind and Cardozo framework further by introducing the nested approach (figure 4.6). Their concept is based upon the assumption that three factors influence the purchase process: the company (demographics, operating variables and purchasing approach), situational factors and personal characteristics of individuals.

The marketer moves from the outer nests, containing more general and easily obtainable segmentation bases, to the inner nests with the more specific ones.

They do not, however, provide a tool to decide when to stop and do not elaborate on the methodological difficulties in obtaining data.

Cheron and Kleinschmidt (1985) in a more recent contribution tried to bridge the gap between industrial markets and consumer markets by introducing an integrated framework. They concentrated on collective buying decisions only. Their framework is presented in figure 4.7. This approach is obviously only applicable to group practices in the GP market.

4.4 Summary

The role of market segmentation in the development of a marketing strategy has been stressed and important considerations in the process of segmentation have been explained.

A few bases for segmentation mentioned in the literature do provide useful starting points for a segmentation of the GP market. Geographic and demographic information such as age, sex, single/group practice can provide helpful approaches. Psychographic aspects provide little support due to a lack of information.

Probably the most powerful approaches include the analysis of consumer response. Here the attitude and perception of a product versus its competitors' in the product class, provide the best bases. Thus, a similar approach to benefit segmentation could be pursued but the lack of information on GPs' value system creates difficulties. In addition, the usage rate could be an interesting basis as well as the identification of the "heavy half".

Bases from industrial market segmentation research include the organisation type, namely single or group practice. The organisational role in a group practice is of high interest but very difficult to assess. End use of the product is difficult to use due to the lack of information. The perceived risk could be an important factor to consider. Behavioural differences, such as response to promotional activities or attitudes towards products, are other interesting bases.

The research in normative approaches provides some guidance of how to use the different bases just listed.

Whether it is called a "nested approach" or "two stage segmentation", the basic idea is to pre-segment the market in macro-segments using general data such as demographic data. These macro segments can then be further segmented using more specific bases like attitudes, perceived risk, or promotional response.

I. Problem Definition
- (a) Managerial requirements
- (b) Baseline vs on-going segmentation
- (c) Segmentation model

II. Research Design
- (a) The unit analysis
- (b) Operational definitions
- (c) Sample design
- (d) Data reliability
- (e) Segment stability
- (f) Segment homogeneity
- (g) Segmentability of the market
- (h) Validation
- (i) Cost considerations

III. Data Collection
- (a) Primary vs secondary sources
- (b) Conventional vs new data analysis procedures

IV. Data Analysis
- (a) For determining the segments: Classification
- (b) For determining the segments' profile: Discrimination
- (c) For simultaneous classification and discrimination

V. Data Interpretation and Implementation of Results
- (a) Determining the number of segments and selection of target segments
- (b) Translating segmentation findings into strategy

Figure 4.1 Framework market segmentation (adopted from Wind, 1978)

Segmentation Variables	Measurable	Available	Predictive	Usage
Product/Process	1	1	3(?)	1
Application	2	2	1(?)	1
Industry Type	1	1	2-3	1
Market Size	1-2	1	1-2	1
Geographic Location	1	1	?	1
Buying Process	2-3	2-3	?	1
Buying Centre	2-3	2-3	1(?)	2-3
Previous Relations	3	3	1(?)	3
End-User	2	2	1(?)	1-2

1 = high, 2 = medium, 3 = low

A question mark implies a need for further research.

Figure 4.2 Assessment of variables for industrial market segmentation (Johnson and Flodhammer, 1980)

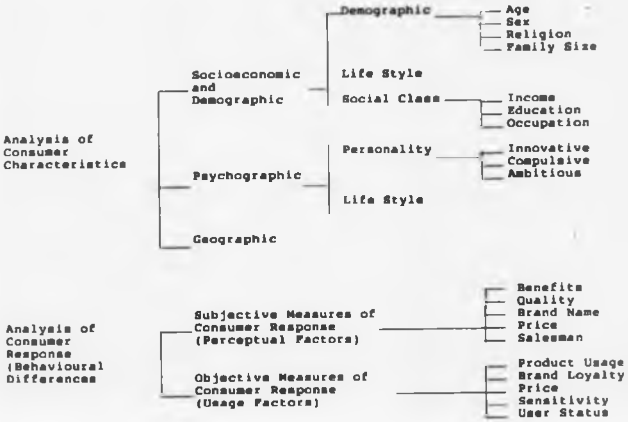


Figure 4.3 Bases for Consumer Market Segmentation

A. Organisation:	- Type	Spekman 1981
	- Industry Type	Hummel 1954/1960
	- Demographics	
	- Geographic	
B. DMU:	- Composition	
	- Degree of Decentralization	
	- Decision Rules	Wilson, Matthews and Sweeney 1971
C. Individual	- Demographics	Schiff, Fernandez and Winer 1977
	- Organisational Role	
D. Product	- End Use	Unger 1974
	- Economic value to the customer (EVC)	Farbis and Mehta 1981
	- Quantity	
E. Behavioural Differences:	- Buying situation	Robinson, Faris and Wind 1967
	- Source loyalty	
	- Risk perceived	Cardozo 1968
	- Benefits	Yankelovitch 1964 Hlavacek and Reddy 1985

Figure 4.4 Bases for industrial market segmentation

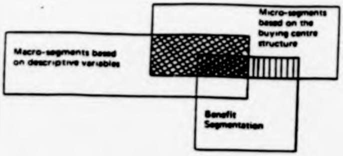


Figure 4.5 Requirements for implementation of segmentation framework (Cheron and Kleinschmidt, 1985)

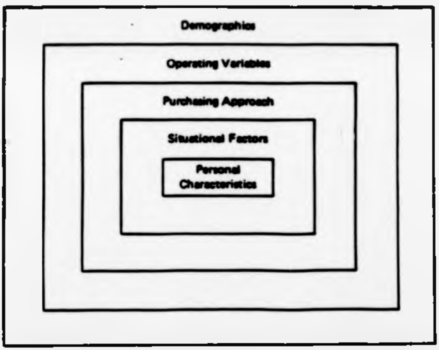


Figure 4.6 Nested approach (Shapiro and Bonoma, 1983)

	Consumption Unit	Individual group forming household, family group, organisational group	
	Segmentation type	Macro-segmentation	Micro-segmentation
	Segmentation variables	General descriptive	Situational specific
Segmentation Procedure	A priori	Descriptive variables: economics, demographics 1	Specific variables: group composition, purchasing activities 2
	A posteriori	4 Descriptive variables connecting group differences on involvement structures	3 Differences of participation and involvement of members in observed activities

Figure 4.7 Integrated framework: consumer/industrial market segmentation
(Cheron and Kleinschmidt, 1985)

Chapter 5 RESPONSE BASED SEGMENTATION OF THE GP MARKET

5.1 Introduction.

The first chapters in this thesis explained the need for market segmentation of the GP market in the UK, the previous chapter has outlined various approaches to market segmentation. This chapter reports on findings on a segmentation study conducted on the basis of data described in section 3.6 of this thesis.

Segmentation of the market in the case reported here is conducted with the objective of using these segments to allocate the marketing budget more effectively, ideally with the assistance of a model to be developed in subsequent chapters. Therefore the segments to be identified will form an input to the model to be developed.

Segmenting with the objective of more effectively allocate the marketing budget requires analysis of the market to examine whether groups of customers with a similar response to marketing effort can be identified. The importance of responsiveness is highlighted by Kotler (1984, p.123) when he stated that:

> 'Of central interest is the question, how do consumers respond to various marketing

stimuli that the company might arrange? The company that really understands how consumers will respond to different product features, prices, advertising areas, and so on, will have enormous advantage over its competitors'.

Consequently, this chapter is thus testing the hypothesis

H3: It is possible to define market segments on the basis of response to marketing stimuli.

The introduction into the methodology applied is followed by a discussion of the results and a summary of the findings.

5.2. Methodology.

If segmentation is conducted with the aim of allocating promotional expenditure, then the response to promotional effort is the best basis for segmentation. This is because it is a waste of resources to ignore differences in response to marketing effort and to spend effort equally on individuals who are less likely to respond to the chosen stimuli than others. Thus, response based segmentation is a meaningful way of market segmentation with the view of allocating promotional resources.

The basic concept of response based segmentation as demonstrated in figure 5.1 is as follows:

Purchase behaviour is measured at two distinct points in time. Relating the change in purchase behaviour to expenditure on promotional stimuli, i.e. sales force, direct mail or advertising, then individuals' responsiveness can be measured. This is exactly the aim of the exercise, to identify doctors who are similar in their response to promotional effort.

Figure 5.2 summarises the steps taken to conduct this analysis. As explained in section 3.6, data sets covering two snapshots are available. Brand preference is chosen to represent purchase behaviour in the absence of access to 'real' prescription data. When filling in the questionnaire the doctor clearly stated his or her attitude. In the light of the discussion of buyer behaviour in section 3.3.1 it is controversial to assume that a change in attitude will be followed by a change in behaviour. That is it is not necessarily guaranteed that more prescriptions are written once a more positive attitude towards a drug is achieved.

Fishbein (1967) concluded that there is no consistent evidence supporting the hypothesis that knowledge of an individual's attitude will allow the prediction of the way he will behave. Engel and Blackwell (1982, p 442), however, concluded that for a high involvement decision, as which the prescription of drugs is treated in this thesis (chapter three), the link between attitude and behaviour is closer than in low involvement decisions. They claim that a change in attitude is a valid marketing goal. Consequently, it is not unreasonable to treat brand preference as a proxy for purchase behaviour in the absence of access to 'real' prescription data.

Due to the Government's amendments to the limited list discussed in chapter three, various drugs could not prescribed further through the NHS. Consequently, changes to the questionnaire had to be made to accommodate the new situation when it was sent out for the second time. This does to some extent hamper the ability to analyse change in preference, because obviously the comparison has to be for like with like. Here for some therapeutic classes it was impossible due to the different products listed in the questionnaire.

These changes ruled out hypnotics as a class to analyse due to the introduction of generic prescribing. Therefore, the analysis is conducted for two therapeutic classes of interest to the company, contraceptives and anti-rheumatics. These were the only classes of interest that stayed stable over the period in question. The analysis for each class is carried out independently from the other. The data available for the two classes are biased to some extent since the sequence of products as listed in the questionnaire was apparently not changed. Thus, a bias towards those products which are listed first in the questionnaire might be expected. However, there is no evidence that this possible bias actually materialised.

The objective of the analysis here is to identify those doctors who are significantly responsive to promotional effort. The sequence of the analysis is displayed in figure 5.2.

For a particular product in a given therapeutic class, the doctor will have had a certain preference. Again a certain preference will have been stated in the second questionnaire. A weighting as displayed in table 5.1 for the permutation of possible changes in preferences is given and is being allocated to doctors in the second step of the analysis. In this second step each doctor is being allocated a value for each product in the class to be examined to express the doctor's change in preference.

As indicated in step 3 (figure 5.2), the matrix showing the doctors on the vertical axis and the change in preference for products on the horizontal axis has to be turned around. This turning of the matrix was unfortunately not possible on the version of SPSSX on which all the other analyses discussed in this thesis were conducted. The data at this stage had to be transferred to a system called SAS which offered the required facilities.

In step 4 promotional expenditure is added for individual products broken down into sales force and direct mail/advertising.

For each individual doctor a separate regression analysis according to step 5 is conducted. Then the final step allows the identification of individuals who are statistically significant in their response.

5.3 Response Based Segments

Table 5.2 summarises the results of the individual regression analysis.

For anti-rheumatics the results are very discouraging. The one-tail and two-tail tests indicate that only very few doctors are statistically significant in their response to promotional effort. There is only a marginal difference between the actual and expected number of responsive doctors.

Similar results are obtained for contraceptives. The individual effects of journal advertising/direct mail and sales force are not conclusive. However, the combined effect of all promotional activities is significant. Many more doctors shifted their preference towards drugs on which was spent a high proportion of promotional activities.

Only for contraceptives the combined effect of promotional effort indicates a higher than expected number of responsive doctors. But even this is only slightly more than 10% of the population of doctors. The questions that arise from this analysis are:

- Are only 10% of all doctors responsive to promotional effort? i.e. does promotional effort not work, is it a waste?

- Who are the responsive doctors?

- Are doctors who are responsive in one therapeutic class, responsive in others as well?
- Should promotional effort not be geared to those who are responsive?

A more detailed analysis of the profile of the responsive doctors reveals that they tend to be high prescribers in the respective product class. There is a bias toward higher number of prescriptions overall.

These findings are obviously encouraging because they point toward a link between doctors' potential and their responsiveness to promotional effort.

From the analysis presented here, it seems as if promotional activities do have far less impact than might be assumed. At least from these data it does not seem that there is a significant shift in preference towards those drugs on which there were heavy spends. But it has to be borne in mind that this analysis is based on only two therapeutic classes. Hence the conclusion stated above has to be treated with appropriate care. There is no significant correlation between doctors who are responsive in either class. Further work is necessary to establish links. The problem, however, is which therapeutic classes to include to achieve an accurate picture. As outlined above, the structure of the data available does not allow the conduction of this analysis across all therapeutic classes. Thus, the analysis as presented here has to be limited to a snapshot of two therapeutic classes.

Do these discouraging results not postulate the reduction of promotional spending or even its complete deletion? Yes, there is evidence that promotional expenditure does not work as might be expected in winning <u>new</u> customers. However, this, winning of new customers, can only be one aspect of the success of promotional expenditure. The other obviously is to attract the <u>current</u> customers. The regression analysis explained above will not have detected those individuals who <u>maintained</u> their preference for a highly promoted product. Thus, the regression analysis is geared towards detecting aggressive gains, and is obviously neglecting defensive moves.

This discussion needs to be seen in the light of objectives for promotional activities. As far as the brand attitude is concerned, Rossiter and Percy (1987, p.152) distinguished four objectives:

- to create brand attitude when the target market is unaware
- to increase brand attitude when attitude has only been moderately favourable.
- to maintain brand attitude when maximal favourable attitude existed already
- to modify brand attitude for re-positioning purposes
- to change brand attitude when a negative attitude existed

Since the data available did not allow the detection of a negative attitude and measured preference only in relation to a given therapeutic class, changing and modifying attitudes could not be addressed in this thesis. Only the objectives of increasing and maintaining attitude as a result of promotional expenditure could be addressed here.

This defensive element in promotional efforts can best be illustrated using table 5.3. There, for the leading contraceptives their 'current' market share (as of the second snapshot) is related to how this translates into preference as far as the database is concerned. I.e. the 18.4% market share of Logynon is equivalent to 10% of doctors having this product as first choice, 3% as second choice etc. The next column displays the sales increase over the period of the two snapshots, i.e. 16% increase for Logynon. The last column indicates the proportion of promotional effort for a product relative to total promotion for contraceptives, i.e. Logynon accounted for 16.5% of total promotion. Underneath, figures are given for how the preference has changed. The expenditure has had little impact on 21% of GPs who are still not prescribing the drug. Another 21% have gone down in their preference, while 32% of GPs indicated an increase in preference for Logynon.

The example shows two interesting pairs of products. Logynon and Microgynon, as well as Trinordinol and

Ovranette. Both pairs have similar market shares (18.4%/17.3% and 9.3%/8.9% respectively). Within both pairs there are differences in success. While Logynon's sales went up 16%, Microgynon's only increased by 8%, Trinordinol's sales increased by 9%, Ovranette's only by 4%. Can these differences be explained by the completely different promotion strategies?

The successful products account for 16.5% and 13.4% of total promotional expenditure in this class, while on the two less successful ones next to nothing was spent. However, a more detailed look at how promotional expenditure has worked stems from the figures in the third column in table 5.2. For the first pair there is hardly any difference in the number of people who increased their preference. 32% went up in their preference for Logynon, 29% increased theirs for Microgynon. A similar pattern can be observed for Trinordinol, and for Ovranette, up 27% and 26% respectively. Clearly, the difference in promotional effort had no visible effect on the number of doctors increasing their preference.

On the other hand, staggering differences can be observed when looking at the other side, losing preference. For Microgynon, 27% went down in their preference; almost as many as increased the preference.

Logynon, however 'lost' only 21% of doctors, which is considerably less compared with those who were won. A similar pattern was seen for the other pair: Ovranette 'lost' 25% while Trinordinol only lost 19%.

These differences indicate very clearly the importance of promotional effort in reassuring and maintaining current customers. It seems as if the increases in sales for the two highly promoted products were mainly achieved by losing fewer of their existing customers.

5.4 Summary.

This chapter analysed the dynamic behaviour of GPs. It tried to segment the market on the basis of response to promotional effort. The results in two therapeutic classes indicate that only a few more doctors, compared with expections from random data, are significantly shifting their preference towards products which are heavily promoted. The results indicate that segmentation purely on the basis of response, although very desirable under the objective of allocation of promotional effort, is not feasible with the data available.

It is, however, argued that winning new customers (i.e. increasing preference for a product) is only one aspect of how promotional efforts work. The other is the value in <u>maintaining</u> loyalty of current users. In an example of the contraceptive market it is demonstrated how, with completely different promotion strategies, products won a similar number of new customers, but that those products on which little was spent lost a significant higher number of current customers. In that example promotions worked clearly to the effect of keeping preference at a high level rather than increasing it. There are strong indications that these phenomena caused a significantly higher increase in sales for the promoted product. These findings led to the conclusion that segmentation based purely on dynamic aspects would not lead to very meaningful results.

The conclusion drawn from the work reported in this chapter is that hypothesis H3 has to be rejected. The analysis of the available data could <u>not</u> establish that it is possible to define market segments on the basis of response to marketing stimuli. Consequently, the following chapter describes a different approach to market segmentation to overcome the problems encountered with dynamic approach to segmentation. A static approach, analysing the market at one particular point in time, avoids the problem of non-compatibility of data experienced in the approach described in this chapter.

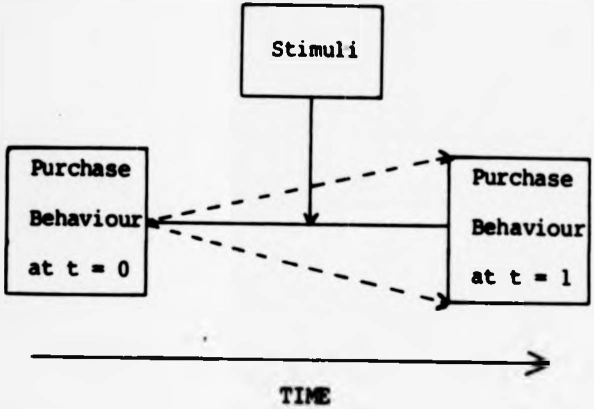


Figure 5.1 The concept of response based segmentation

1. Compare change of preference in product class:

Old Data	New Data
first	first
second	second
third	third
other	other
no	no

2. Allocate a value for each product to express each doctor's change.

3. Turn around the matrix.

Before

P1 ... P23

D1

.
.
.

D1000

After

D1 ... D1000

P1

.
.
.

P23

4. Add promotional expenditure

D1 ... D1000 SF JM

P1

.
.
.

P23

5. Regression Analysis for each individual doctor to express the relationship of change in preference and promotional expenditure.

$$S = aSF + bJM + c(SF \times JM) + U$$

S Change in preference
SF Sales force expenditure
JM Journal advertising/direct mail expenditure

Figure 5.2 Sequence in conducting response based segmentation in a therapeutic class

Change in preference

1 first choice
2 second choice
3 third choice
5 other choice
9 no choice

From\TO	1	2	3	5	9
1	0	-4	-5	-8	-10
2	4	0	-1	-4	-6
3	5	1	0	-3	-5
5	8	4	3	0	-2
9	10	6	5	2	0

Table 5.1 Weightings for change in preference

Doctors who are responsive to:

Antirheumatics

	Two-Tail Test	One-Tail Test
Journal/direct mail	2.7%	6.5%
Sales force	3.9%	7.3%
Combined	2.2%	4.9%

Contraceptives

	Two-Tail Test	One-Tail Test
Journal/direct mail	3.8%	6.7%
Sales force	3.1%	4.7%
Combined	7.8%	11.7%

Calculations are based on the 5% level significance.

Table 5.2 Results of response based segmentation

	Current Market Share		Sales Increase	Proportion of Promotion
LOGYNON 08	18.4%		+16%	16.5%
	10%	First		21% stable no
	3%	Second		
	2%	Third		21% down
	11%	Other		32% up
MICROGYNON 10	17.3%		+8%	.2%
	12%	First		14% stable no
	6%	Second		
	2%	Third		27% down
	10%	Other		29% up
TRINORDIOL 21	9.3%		+9%	13.4%
	3%	First		34% stable no
	2%	Second		
	1%	Third		19% down
	14%	Other		27% up
OVRANETTE 19	8.9%		+4%	.6%
	5%	First		25% stable no
	3%	Second		
	2%	Third		25% down
	14%	Other		26% up
EUGYNON 04	7.6%		(33%)	1.8%
	1%	First		36% stable no
	2%	Second		
	1%	Third		18% down
	14%	Other		28% up
MARVELON 09	4.9%		44%	11%
	1%	First		58% stable no
	1%	Second		
	1%	Three		11% down
	9%	Other		19% up
MINOVLAR 14	1.7%		(30%)	.3%
	4%	Other		76% stable no
				11% down
				8% up

Table 5.3 Promotional expenditure and change in preferance

continued .....

	Current Market Share	Sales Increase	Proportion of Promotion
FEMULEN 06	2.5%	1%	.4%
	1% Third		69% stable no
	9% Other		
			10% down
			11% up
LOESTRIN 07	3.7%	+7%	13%
	1% First		56% stable no
	1% Second		
	10% Other		18% down
			13% up
BREVINOR 01	3.6%	(22%)	-
	2% First		49% stable no
	1% Second		
	13% Other		19% down
			16% up
BINOVUM 02	3.9%	(14%)	.3%
	1% First		59% stable no
	1% Second		
	11% Other		13% down
			14% up
DEPOPROVERA 24	0.2%	+67%	-
			93% stable no
			7% up

Table 5.3 contd.

Chapter 6 STATIC SEGMENTATION OF THE GP MARKET

6.1 Introduction

In chapters one and two it was explained that it is intended to develop a model assisting in the resource allocation to products, market segments and promotional tools. The area of analysis has focused on the GP market in the UK. Chapter three concluded that the scarce resources of the marketing budget should be focused on those doctors who are likely to give the highest return to the promotional expenditure. This obviously calls for segmentation of the GP market. Consequently, aspects of market segmentation have been reviewed in chapter four. It is apparent that creativity and open-mindedness are keys to a successful segmentation study.

This chapter builds on the conclusions drawn and summarises static approaches to market segmentation. Static segmentation refers to the segmentation study being undertaken at a particular moment in time. Such a 'snapshot', in this case, is provided by segmenting the market based on the 1985 data only.

Segmentation is only meaningful when the segments identified reflect a difference in response to marketing stimuli. This aspect was addressed in the previous chapter, when an approach to dynamic segmentation, (segmentation based on change in response over time), was discussed. However, the conclusion taken from the previous chapter is that the data available in this case are not sufficient to establish viable segments based on response to marketing stimuli.

In the absence of sufficient data to identify dynamic segments, it is attempted in this chapter to test hypothesis H4 which states, that it is possible to define static segments which reflect dynamic behaviour. The test of this hypothesis will then be linked to testing hypothesis H1 which states that segmentation can be used to allocate sales effort.

The results of the static segmentation approach are summarised in four steps. First, the methodology in approaching the segmentation study is outlined. Then the results of the macro-analysis, that is segmentation based prescriptions <u>across</u> a number of therapeutic classes, are presented. This is followed by the third section which outlines the procedures taken to validate the findings. The following section then presents the conclusions drawn from the findings and a discussion of an example of the micro-analysis, which is a segmentation study based on preference <u>within</u> a therapeutic class. The final section in this chapter summarises the findings.

6.2 Methodology

The objective is to segment the GP market so as to allow the most effective allocation of the marketing budget, sales effort in particular. Therefore, the aim has to be to single out segments in the markets which have high potential for prescribing and which are responsive to promotional effort.

This chapter discusses two approaches to static market segmentation based on the macro-analysis and on the micro-analysis.

The analysis at the macro level aims to identify groups of doctors within the GP population in general, not specifically related to a particular therapeutic class. This analysis is helpful in understanding the structure of the GP population, in order to make decisions relative to the product portfolio.

The analysis at the micro level aims to identify groups of doctors relative to a specific therapeutic class. The understanding of the market structure in a particular therapeutic class enables segmentation and targeting for a particular <u>product</u>.

The focus in this chapter is on the macro-analysis, an example of the micro-analysis is discussed in section 6.5.

The Company in the example used here is only operating in a limited number of therapeutic classes. Therefore, the market could be segmented just on bases important to those classes. For the macro-analysis, however, it is important to identify groups of GPs independently from the current product portfolio. This will give an understanding of the market structure as a whole. This less biased approach overcomes the problem of using an _a priori_ variable to discriminate between groups, whereby the choice of the _a priori_ variable dictates the outcome.

Theoretically, the problem of choosing the bases for segmentation can be solved using Automatic Interaction Detection (AID) (Assael, 1970) by sorting through large numbers of alternative bases to produce a hierarchy. As demonstrated by Doyle and Fenwick (1975) its application has been found to be unreliable and misleading, mainly due to the successive splitting of the market producing very small cell sizes unless very large samples are available.

Whereas AID achieves the hierarchy of bases by sequentially taking an _a priori_ basis, cluster based segmentation (Green 1977) uses cluster analysis to group on a number of criteria simultaneously. This less biased approach offers the advantage of seeking out meaningful segments from a large data base (Saunders 1980, p. 442).

Purchase behaviour or descriptive information can both be used for a priori or cluster based segmentation. From the practitioner's standpoint purchase behaviour is the primary classification criterion because it focuses upon the very action the marketer is trying to change. Descriptive information, however, can provide a deeper understanding of the segment under examination, but by itself is a less useful guide to strategy (Brown 1983). This is mainly true because descriptive information can only act as a proxy for purchase behaviour.

Beside a priori and cluster based approaches, Wind (1978) distinguishes two other segmentation approaches - flexible and componential designs. Both designs rely on compound analysis and were discarded as being inappropriate in this study due to the number of products in the GP market and type of data available.

The approach taken in this case is in analogy to Bonoma and Shapiro's (1983) nested approach, as outlined in figure 4.6 in chapter four, whereby the segmentation process is conducted from the outer nests, containing the more easily obtainable segmentation bases, to the inner nests containing the more specific ones. As discussed in previous chapters, a priori segmentation had been applied to focus on the GP market within the NHS market as opposed to the hospital market or the private prescription market.

Consultations with market research companies and with the Company's sales representatives, sales managers, marketing managers and market research personnel revealed that beyond this a priori segmentation there was no clear evidence for how the market could be further divided. The existence of various segments was hypothesised but no clear basis for segmentation emerged.

In order to achieve an unbiased approach (Saunders, 1980 p.442) to segmentation it was then decided to apply cluster analysis since no other a priori bases could be established. Following the a priori segmentation which identified the GP segment, the aim is to group doctors according to more specific variables, thereby taking into account the variables in the inner nests following the nested approach to segmentation.

Everitt (1974, p.7) classified cluster analysis techniques into four main types:

(i) Hierarchical techniques - in which cases or entities are classified to demonstrate hierarchical connections (Zupan 1982 p.13).

(ii) Optimisation - partitioning techniques - in which clusters are formed on the basis of optimising a clustering criterion.

(iii) Density or mode-seeking techniques - in which clusters are formed by searching for regions containing dense concentrations of cases or entities.

(iv) Clumping techniques - which allow an overlap of classes or clumps.

Blashfield and Aldendefer (1978) in an analysis of published articles based on the use of cluster analysis found that agglomerative hierarchical methods were by far the most dominant methods as far as frequency of application is concerned. Subsequently, the focus of this review will be on those agglomerative hierarchical clustering methods.

Hierarchical clustering techniques may be subdivided into agglomerative methods and divisive methods. While the divisive methods partition the set of N entities into finer partitions, agglomerative methods proceed with a series of successful fusions of the N entities into groups (Everitt 1974, p.8).

Aldendefer and Blashfield (1985, p.35 pp) distinguished the following agglomerative methods:

(i) Single Linkage (Sneath 1957)

Cases are joined to existing clusters if at least one member of the cluster is at the same level of similarity as the one under consideration.

(ii) Complete Linkage (Sokol and Michener 1958)

Cases will be joined to existing clusters on the basis of similarity to all members.

(iii) Average Linkage (Sokol and Michener 1958)

Cases are joined to existing clusters on the basis of similarity to the average member.

(iv) Ward's Method (Ward 1963)

Cases are joined to existing clusters as to maximise the variance within clusters.

The objective function measures the error sum of squares (ESS) according to

$$ESS = \sum_{i=1}^{n} (X_i^2 - 1/n (\Sigma X_i)^2)$$

with X_i being the score of the ith case of n cases.

Consecutively joining cases on the basis of minimising the error sum of squares leads to a hierarchy of clusters starting from the stage at which all cases are in their own cluster to the final stage when there is only one cluster. It is obvious that there is a strong increase in 'stress' (ESS) at the final stages of the clustering process, when the most differing cases are combined.

Blashfield (1980) found that Ward's method is widely used in the social sciences. In the case reported here it was found to produce the most robust solutions, which is in line with results of previous studies (Blashfield 1976, Wishart 1978).

Having outlined the various clustering techniques and having decided to use Ward's method, it is then important to decide on the variables to include in the cluster analysis.

Since it was the aim to identify groups of doctors who behave similarly, it was decided to use the behavioural data to segment the market, leaving the demographic information to describe the groups.

Ideally, the analysis could have been conducted at the brand level, measuring brand preference. Since the data contain information on several hundred brands, the statistical validity is not secured with 'only' 1000 cases, besides the enormous computational demand which makes this approach infeasible anyway.

In order to overcome the problem of the large number of brands a solution could have been to sample brands to include in the cluster analysis. This approach was rejected in favour of a more comprehensive approach. Rather than arbitrarily sampling the variables, the analysis was conducted at a higher level, based on a census.

The data available (C.F. questionnaire in appendix 1) not only identified the doctors' brand preference in a therapeutic class but also the number of prescriptions written in the therapeutic class in question. At the level of therapeutic class the number of prescriptions written in a class is treated as a variable. As variables are included in the analysis the number of prescriptions written in all 43 therapeutic classes covered in the questionnaire to guarantee an unbiased approach.

It is common to normalise and factor analyse data prior to clustering. In this case normalisation was not conducted because it would have caused overall high and low prescribing GPs to be treated the same as if they prescribed therapeutic classes in similar proportions. This would have been less useful than identifying GPs who were overall high prescribers. For the same reason factor analysis was not conducted (it automatically normalises data) and, besides, enough processing power was available to conduct clustering without data reduction.

To illustrate the approach further and to justify why all classes have been considered instead of clustering on the basis of factors is the more important since the magnitude of values between variables differ. As can be seen in the questionnaire displayed in appendix 1, the highest level classifying prescribing in the therapeutic class of <u>betablockers</u>, for example, is more than seven prescriptions per week. For <u>contraceptives</u>, for example, the scaling is different to the extent that seven to nine prescriptions per week only qualify for the second highest level on the scale, while the highest level is in excess of ten prescriptions per week. The differences in scaling take into account the relative level of prescribing in the various therapeutic classes.

However, the aim is to identify doctors who are similar relative to other doctors. Therefore, the absolute number of prescriptions in a therapeutic class with, for example, relatively few prescriptions compared to others, is of little value. What is important, however, is to determine that even in a class with a few prescriptions, the doctor is a relatively high or low prescriber. Secondly, if the objective is to have an unbiased approach then there is little value in grouping therapeutic classes which bear no relationship with each other. There seems to be no logical reason why one should group, say, betablockers and contraceptives.

Consequently, all therapeutic classes are considered with equal weight. Thus, a compromise has been found between the desire for an unbiased approach and the need for a meaningful number of logical variables to be included in the cluster analysis.

6.3 Macro-Analysis

Using the methodology outlined in section 6.2 in the Macro-analysis seven groups of doctors are identified as segments in the GP market. Using demographic information to describe doctors in the groups, the following profile can be drawn. The results of the Macro-analysis are displayed in table 6.1. This section provides an overview of the segments identified.

'Dr Average'

Approximately one fifth of the population could be described as being average. Across the therapeutic classes these doctors prescribed an average number of prescriptions. All the other information available underlines that picture. Although they tended to work in slightly larger than average sized practices they reported to prescribe overall slightly less than expected.

'Early Majority'

This group consisted of high prescribers across the therapeutic classes. This large group, a quarter of the population, consisted of active doctors, who prescribed new drugs earlier than the rest of the population, hence the label. The high number of prescriptions written by members of this group is reflected in their self-reported classification. The high number of prescriptions is related to the above average size of the practice and the number of patients each is responsible for. This highly attractive group only saw an average number of pharmaceutical representatives.

'High Energy'

Only 10% of the population could be labelled as 'High Energy'. These were very high prescribers across the therapeutic classes and were male dominated. Being older, and more experienced, they tended to be involved in the early stages of new drug introductions. Doctors in this group scored the highest points across demographic criteria. Their high number of patients and prescriptions was paired with a high number of pharmaceutical representatives seen.

'Young Conservative'

A large group in the GP population was prescribing little across therapeutic classes. These doctors were younger and conservative as far as the adoption of new drugs was concerned. Their conservative prescribing behaviour may have been due to their more recent education, which emphasised on writing fewer prescriptions. To some extent the few prescriptions can be explained by the below average number of patients seen by doctors in this segment.

'Thrifty Housewife'

Twice as many women are in this group compared with women' share of the total population. Their very low number of prescriptions can be explained by the fact that quite a large number of female doctors worked on a part-time basis. Consequently, they could only see few patients, hence their low prescribing compared with other groups. The male part of this group consisted of older, and probably semi-retired doctors.

'Odd Balls'

This very small group (3%) is described by its very erratic prescribing behaviour across therapeutic classes. Doctors in this group basically had in common that they did not fit in with any other group. Since it is only a small group there is no practical significance in pursuing a further analysis.

'Quasi Homeopath'

Approximately four percent of doctors can be described as 'Quasi Homeopaths', since apparently they did not prescribe at all, or just very little. There was no clear pattern of this rather small group as far as demographic information is concerned. Thus it should be treated in a similar way as the 'Odd Balls': with little attention.

6.4 Validation

The existence of the segments identified and described in the previous section must be validated. The most comprehensive framework for validating cluster based segmentation was developed by Choffray and Lilien (1980,
Appendix 4.2). They suggested a three step process:

1. Tests on the sensitivity of cluster analysis.

2. Tests on the non-randomness of the structure observed in a dissimilarity matrix, and the determination of the number of clusters retained.

3. Determination of the non-uniqueness of the clustering solution retained.

6.4.1 Elimination of outliers

In order to obtain intra-segment homogeneity, thereby decreasing the sensitivity of the cluster analysis, the data need to be searched for extreme outliers. Their inclusion in the analysis would distort the picture and would artificially create less robust groupings.

According to Blashfield's (1976) suggestion, single linkage cluster analysis was applied. This clustering method combines clusters on the basis that every member of the cluster is more similar to at least one member of the same cluster than to any member of any other cluster. This process tends to generate long, loosely connected clusters.

Outliers in this process, those individuals who are fitted into groups under increasingly higher stress in the final stages of the clustering process, are easily detected and subsequently 24 doctors were excluded from further analysis. This procedure enabled the achievement of more robust clusters without the distorting influences of these extreme outliers.

6.4.2 Non-randomness of the data structure

The choice of the number of clusters in the final solution is a problem with all clustering techniques. Some authors (e.g. Friedman and Rubens 1967) suggested that the number of clusters should be set when the further combining of clusters results in a disproportionate increase in stress. This is a rather crude method but inspection of the dendrogramme (figure 6.1) indicates a leap in stress at the seven cluster solution which is more than double the increase in stress compared with the eight and nine cluster levels.

In order to test for non-randomness in a more sophisticated way Choffray and Lilien (1980 p.200) recommended the generation of five to ten random data sets on which to apply the same method of cluster analysis. This process is undertaken to ensure that the results obtained from the cluster analysis of the data in the sample are significantly different from the results achieved with random data.

Subsequently, ten random data sets covering the relevant number of cases were generated. As in the case of the original data set, Ward's method was applied. Figure 6.2 demonstrates the results of the cluster analysis of the random data compared with the actual results. The increase in stress is plotted against the level of clustering. This analysis remains inconclusive as to which level of clustering is the appropriate one. Doyle and Saunders (1985, p.30) succeeded in supporting their choice of clustering level conclusively using this method.

Although this first test for non-randomness remained inconclusive, a further test could be applied. Using the clustering methods complete linkage, average linkage and the centroid method, cluster memberships were compared with the solution obtained by Ward's method. As expected, the solutions were not identical, but 67.7, 54.6 and 68.1 per cent of of the cases respectively were allocated to the same clusters. The null hypotheses that these allocations were random could be rejected with 99.9 per cent confidence.

Managerially, none of the statistical tests for the number of clusters is satisfactory (Saunders 1980). For management the real criterion is the utility of the solutions. This depends on such factors as the value of the segment, its accessibility, competitive activities, and management's capacity to implement different segmentation strategies. The approach taken was to present to management as clearly as possible several levels within the clustering hierarchy, so that they could choose which one to adopt.

Initially, the seven cluster solution was presented along with the eight and nine cluster solutions, which brought a split in the groups of 'Early Majority' and 'High Energy' (Maier 1986). The profiles of these new segments are outlined in table 6.2.

The segment of 'High Energy' which itself is a relatively small segment accounting for ten percent of the population broke down almost equally into two smaller segments. The smaller of the two contained the less active members of an already very active group of doctors, which showed a high involvement in clinical trials, hence the label 'Initiator'. The second group is less innovative but very active. The label 'Enthusiast' seems to describe members of this group adequately.

The segment consisting of the 'Early Majority' which overall showed a strong interest for Paediatrics (child-related illnesses) broke down into two smaller segments with a strong discriminating display of interests. While the larger group still expressed a strong interest for paediatrics, the smaller group is described by the complete lack of interest for this part of medicine. 'Child Lover' and 'Kinderschreck' are the labels chosen for these two groups.

Management liked the idea of being even more precise, but finally the seven cluster solution was adopted on the grounds of utility. It was found that the seven cluster solution adequately reflected management's perception of the market, moreover, with larger groups identified as unique segments there is obviously less danger for the solution not being robust.

6.4.3 True cluster solution

To further test for the non-uniqueness of the cluster solution found, the second data set was used as a validation sample. The validation process consisted of five steps:

1. Cluster analysis (Ward's method) of the original data set.

2. Discriminant analysis (Plank 1985) was used to obtain functions describing the characteristics of the cluster solutions.

3. Discriminant functions were applied to the validation sample. Thus members of the hold-out sample were then allocated to the clusters previously identified.

4. Cluster Analysis (Ward's method) of the validation sample.

5. Comparison of cluster memberships.

The overlap in membership as obtained by the discriminant functions was compared with the membership obtained by the cluster analysis. 71 per cent of doctors were allocated to the same clusters. This overlap in the cluster membership is significant at the 99.9 per cent level.

6.4.4 The Experiment

The segments described in this chapter are all based on the analysis of static information, a 'snapshot'.

It is, however, very important to identify groups in the market place which respond differently to elements of the marketing mix. Only then is it really meaningful to segment the market. As demonstrated in chapter four, many segmentation researchers choose as bases for segmentation static market measures (demographics or psychographics) upon the assumption that these bases will explain dynamic behaviour; i.e. a response to the marketing mix.

To test for this assumption, that the static segments identified can be used to explain dynamic behaviour, a natural experiment (Lilien and Ruzdic 1982) was used.

As part of the company's promotional activities, the database was used for a direct mail campaign promoting a mature product. The GPs included in the samples used for the analyses reported here were included in this mail shot. Upon response GPs were offered a free product sample plus a world map as an incentive to respond.

As shown in table 6.3 two segments showed a significant higher response than expected whilst one segment showed a significant lower rate of response.

The low response rate from segment 'Young Conservative' seems to confirm the view that this group does present a considerable problem for pharmaceutical companies. Not only are they below average prescribers, they also seem to be less responsive to marketing stimuli.

The very high response rate from the 'Quasi Homeopaths' is probably surprising but might be explained by a certain degree of 'deal proneness'.

Good news for pharmaceutical companies is the high response rate from the very attractive group labelled 'Early Majority'. This large group consisting of high, fairly innovative prescribers is a very attractive target.

The 'High Energy' doctors probably were too busy to respond, while the group 'Dr Average' did not show any significant difference in response compared to the average.

The results of the natural experiment confirm two important points. Firstly, the results are in line with the descriptions of the segments using the demographic information. Secondly, the results confirm hypothesis H4 which states that static segments can be used to explain dynamic behaviour.

6.5 Conclusions and Discussion

Taking into account the heavily restricted promotional budget, it is very important for pharmaceutical companies to focus their efforts on those segments of doctors which have the highest potential. The database upon which the analysis is conducted offers the unique opportunity for not only determining segments but it offers additionally the possibility of targeting the individual doctor in a particular target market segment.

In consumer markets segments might be identified, thus, it might be known that certain segments exist. The problem, however, is then the second step: targeting. Where are the members of the target market segment? How can they be approached?

Since the database has been set up for targeting purposes, this second step is not a problem in the underlying case. What has been lacking, however, is a first step, a proper segmentation procedure. The results of the macro-analysis provide exactly that. The problem then is somewhat reduced, to the selection of target segments.

However, while the macro-analysis does provide an important overview of different groups of GPs in the total population, it is additionally possible to examine specific therapeutic classes in isolation. This approach is called micro-analysis.

Here the objective is to determine groups of doctors with similar brand preference patterns in a therapeutic class. Thus, a profile of doctors with a certain preference pattern can be drawn. This enables the marketing manager to position the brand, and allows the sales manager to decide which doctors should be reassured in their preference and who should be targeted to be won from the competition.

The benefit of this approach is that it does overcome one of the problems of dealing with databases. The organisation of the MDMO database enables the location of individuals fulfilling the requirements of a specific characteristic, i.e. first choice Mogadon. However, the more specific the profile of the group in question is (i.e. the number of criteria increases), the smaller the population is which fulfills all the criteria. Thus, it is very often the case that management's desire for specific profiles in a population leads to only a few individuals in the desired group. But as outlined in chapter four, segments need to have a certain size to make it worthwhile to pursue a separate marketing programme.

This is exactly where the value of the micro-analysis can be appreciated. The methodology applied is again cluster analysis. The clustering variables measure the preference for a particular drug in the therapeutic class. Values for each product's variables indicate first, second, or third choice, as well as whether the product is an also-run, or other choice. The last value can occur on a doctor's response for a number of products whilst the former are mutually exclusive. Obviously, the same degree of caution is required as for the situation described in chapter six as far as possible bias towards products listed at the top of lists in the questionnaire are concerned. Apparently, the sequence of products listed was not changed. Hence there is a possibility of bias in the data, although no evidence was detected.

Again Ward's method is chosen to identify groups of doctors with a similar preference pattern. The analysis will be explained using the therapeutic class of hypnotics as an example.

Hypnotics can be divided into barbiturates and benzodiazepins. Whilst the former are indicated when a patient suffers from uncontrolled pain, the latter are indicated when respiratory depression is diagnosed (MIMS, 1986 p.61). The reason for choosing hypnotics is that the class contains the Company's most successful product. In addition, this class is a prime example for the confusion observed following changes in the limited list in April 1985.

These changes meant that within the NHS section of the hypnotics market doctors had to prescribe by the generic name. Thus, although there were only thirteen separate names listed on the questionnaire, many more products (brands) were actually available. For example, temazepam was produced under 10 brand names (MIMS 1986). The interesting twist was that while the doctor prescribed the generic product, the Chemist finally made the decision as to which of the temazepams to distribute. As a consequence, there was no need for pharmaceutical companies to promote their brand to doctors any more, in particular when the final decision was being made by the Chemist. This decision was made on the basis of safety and, more importantly, on margins available to the Chemist.

As if this situation was not difficult enough, the company's flagship Halcion, known in generic terms as Triazolam, was still under patent protection. This implied that the only product available under the generic name Triazolam was the brand Halcion. Therefore the company had available a semi-branded product, a differential advantage to be exploited by the use of the promotional mix. It was therefore still worth promoting.

In the context of the size of promotional spending on competitive products, it was then the question of how to spend on the promotional mix and, more importantly, what proportion to spend on current prescribers as opposed to new customers. The other interesting question was which competitive product to attack and which group of doctors to convey the message to. Thus, segmentation on the basis of preference within the therapeutic class of hypnotics was a valuable step towards tackling these problems.

The following segments (table 6.4) were determined for the hypnotics market, in which Temazepam, Triazolam and Nitrazepam are the leading generic products.

Cluster 1, 'Temazepam and Nitrazepam'

This group, 18% of the population, preferred Temazepam and Nitrazepam, both of which were almost used by everybody in this group. This group was distinct from others by its particular dislike of Triazolam. Doctors tended to be older but were not very attractive targets since they prescribed a below average number of prescriptions in hypnotics.

Cluster 2, 'Do Not'

This group consisted of doctors who either did not prescribe hypnotics (41%) or, if they did, had no explicit brand preferences. This is, they did not usually have a first, second, or third choice, but only used a product among others. Consequently, the three leading products are shown as other choices.

These doctors generally saw a fewer than average number of patients and were low prescribers. Not surprisingly, when cross tabulated with the membership of the macro-analysis, this group consisted of 'Thrifty Housewives', 'Odd Balls', and 'Quasi Homeopaths'.

Cluster 3, 'Temasepam, Nitrasepam, Triazolam'

More than a third of the population belonged to this segment. Preference was given to Temasepam but all used Temasepam and Nitrasepam. Significant was the distinct position of Triazolam as being either second or third choice by three quarters of the population. This had important implications, especially since this group tended to be younger (potential for the future!) and saw more than an average number of patients. Above all, this group had a high potential since there was a tendency to high prescribing in that therapeutic class.

This group showed good potential for Triazolam, currently being an also-run. Since the majority of doctors in this group were users already, the usage rate and the preference had to be increased.

Cluster 4, 'Use many brands'

One fifth of the population was distinct in that they favoured a broad variety of products. As reasons for this showing it can be stated that these doctors actually prescribed very carefully different products for different symptoms or, alternatively, that they had to work with patients who were on specific drugs already before they saw the doctor. The latter could quite frequently be observed for Nitrasepam. This relatively old product had been prescribed for years. Older patients were used to (or even addicted to) this product, their doctors were reluctant to switch thus avoiding distressing the patient.

Doctors in this group tended to be older and they tended to write a high number of prescriptions. Therefore it was no surprise to find a number of 'High Energy' doctors in this group.

Cluster 5, 'Temasepam, Triazolam'

With 5% this is the smallest group in the current analysis. These doctors favoured the two new products and disliked the old Nitrasepam. Almost everybody used Triazolam. These doctors were younger but wrote fewer than average prescriptions. This applied also to hypnotics. Therefore, it was no surprise to see 'Dr Average' and the 'Young Conservative' having a stronghold here.

Cluster 6, 'Nitrasepam, Triazolam'

This small group (6%) is different by its dislike of Temasepam. The majority here favoured Nitrasepam, with Triazolam coming second. As suspected, older doctors who had not quite changed their preference over the years, showed in this group. They tended not to prescribe a lot of hypnotics (the lack of opportunity might explain this preference), although overall they were 'Dr Average' 'Early Majority' or even 'High Energy'.

The segments identified with the micro-analysis can be very effectively used for brand positioning. Analysing the profile of segments with a certain brand preference enables the determination of which competitive brands need to be attacked. The marketing mix can then be adjusted accordingly.

It is important to utilise the two approaches for static segmentation suggested in this chapter together and not in isolation. The macro-analysis provides the basic frame for a segmentation study of the GP market, while the micro-analysis can then be used to fine-tune the marketing strategy within a specific therapeutic class. The value of this process can best be appreciated when the macro-analysis is combined with a micro-analysis for each therapeutic class in which a company is operating.

At the first stage, the macro-analysis' identification of seven segments, some implications for the development of a marketing strategy can be shown. By, simplistically, dividing the segments into two groups, the attractive and unattractive segments, a harvest strategy for the latter and a build strategy for the former groups could be recommended.

The 'Young Conservatives', 'Thrifty Housewives' and 'Quasi Homeopaths' constitute 44 per cent of GPs but only account for 20 per cent of reported number of prescriptions. These segments could be harvested. In terms of promotional activities their exposure would be reduced. Obviously this cannot be achieved for advertising due to its inflexibility. They would also still be included in, selected, and usually cheaper direct mail campaigns. The sales force effort, however, would be heavily reduced.

This strategy would liberate funds within the heavily constrained marketing budget. These funds could then be used to build the other market segments. The call rate among existing clients within the group of 'Dr Average', 'Early Majority' and 'High Energy' would be increased.

The existence of the segment of the 'Young Conservatives' does impose a threat to the long term success of pharmaceutical companies. This large group seems to be very careful or conservative as far as prescribing is concerned. Whether this phenomenon is due to a fashionable anti-drug trend or could be attributed to a tendency to 'play it safe' whilst they are 'finding their feet' is difficult to distinguish from this data. However, if this trend persisted, amplified by older doctors retiring, the overall number of prescriptions is likely to decline. This possible threat cannot be left untackled. It is recommended to launch market research activities to obtain a better understanding of this group of doctors. Although these doctors might not currently be an attractive target, their sheer number does require a different approach. It is therefore recommended that campaigns and activities catering for the specific needs of this group must be developed.

An important element of any marketing strategy is the introduction of new products. For new products the segments of the 'High Energy' and 'Early Majority' doctors would be targeted first. They would be treated as the innovators and early adopters (Rogers 1983) with particular emphasis on detailing and direct mail activity. Later in the launch the focus would shift to 'Dr Average'.

Considering the importance of personal selling in pharmaceutical markets, the segmentation procedures outlined in this chapter demonstrated the importance of the allocation of sales effort to segments, thus proving hypothesis H1, which states that segmentation can be used to allocate sales effort.

6.6 Summary

In the previous chapters the pharmaceutical industry was introduced, doctors' prescribing behaviour analysed and the importance of segmentation highlighted. The previous chapter failed to identify significant segments on the basis of response to marketing stimuli. This chapter presents the findings of two approaches to market segmentation on a static basis. The first, the macro-analysis, takes into account the prescribing behaviour across therapeutic classes, the second, the micro-analysis, is based upon preference patterns within therapeutic classes.

The macro-analysis, based on cluster analysis, revealed the existence of seven distinct groups within the GP population. A profile of the seven groups was presented, namely of 'Dr. Average', 'Early Majority', 'High Energy', 'Young Conservative', 'Thrifty Housewife', 'Odd Ball', and 'Quasi Homeopath'.

A set of validation procedures was carried out to prove the existence of these segments. Apart from conducting statistical tests managerial utility is the key aspect in the validation of the findings. In presentations to marketing management, sales management, sales representatives and market research experts in the industry, the seven cluster solution was found to be a valid representation of the reality as experienced by the practitioners.

In addition, the results of a natural experiment supported the view that these segmentation studies produced meaningful segments by detecting significant differences in responses to marketing stimuli. It was found, for example, that the group of 'Young Conservatives' as defined by the static segmentation approach consisted of doctors who were less likely to respond, i.e. they were showing a difference in behaviour, which could have been predicted from the static analysis. This finding proves hypothesis H3 which states that it is possible to define static segments which reflect dynamic behaviour.

Obviously, the macro-analysis can only give a rough guideline as to which doctors to target. For any particular product the situation will be different. Thus, the analysis of a specific therapeutic class is then necessary. This exactly has been done in the micro-analysis.

Demonstrated on the example of hypnotics, groups with similar brand preference pattern are detected, using cluster analysis. This analysis at the brand level enables the tackling of positioning problems.

There is, additionally, scope to match the two analyses. A segment detected by using the micro-analysis can be described in the terms of the macro-analysis. I.e. a segment with preference for product X might consist mainly of 'Young Conservatives', which obviously would have to be treated differently if it consisted of 'High Energy' doctors.

Therefore, the two analyses have to be seen as being complementary rather than seen in isolation.

This chapter has tested two hypotheses:-

H1: Segmentation can be used to allocate sales effort.

H3: It is possible to define static segments which reflect dynamic behaviour.

Both hypotheses have been tested successfully. It was demonstrated that segmentation can be used to allocate sales effort using the example of the pharmaceutical industry. In the same industry it could be shown that static segments did reflect differences in dynamic behaviour. Thus, static bases for segmentation can provide a meaningful way of segmenting a market.

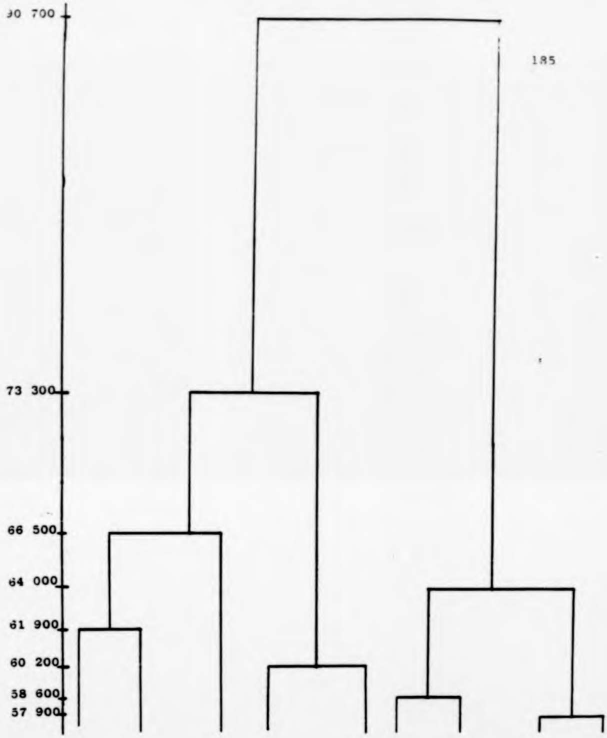


Figure 6.1 Hierarchical clustering dendrogram.

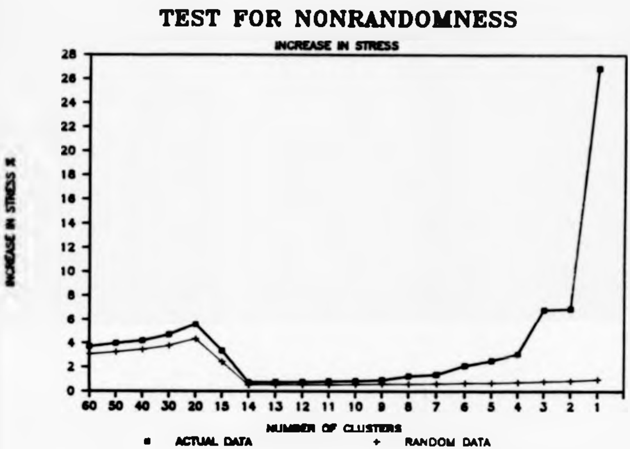


Figure 6.2 Test for non-randomness

	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6	Cluster 7
	'Dr Average'	'Early Majority'	'High Energy'	'Young Conservative'	'Thrifty Housewife'	'Odd Balls'	'Quasi Homeopath'
LABEL		'High Prescribers'	'Very high Prescribers'	'Low prescribers'	'Very low prescribers'		
SIZE	19%	24%	10%	28%	12%	3%	4%
SEX	Male (Average)	Male (above average)	Male!	Male (average)	35% Women!	Male only	Male above
AGE	Slightly younger than average	1936-46	Older (1926-36)	1946-56 Young	Average, but high proportion old	Very young	1936-46
INTERESTS	Dermatology, Gynaecology	General, Paediatrics	Dermatology, General, Obs. & Gynae, Neonatology, Paediatrics	Paediatrics, & Gynae. Neonatology Cardiology	Chest diseases, General, Obs. & Gynae., Neonatology	General, Obs & Gynae. Neonatology	General
INNOVATIVENESS	Average	Average, early adopters	Many clinical trials	Average to conservative	Average to conservative	Common use	Mixed
NUMBER PRESCRIPTIONS	Average to low	Average to high	High	Average to low	Low	Mixed	Towards low
PATIENTS SEEN	Average	High	High	Average to low	Average to low	Average to high	Mixed
REPS SEEN	Average	Average	High	Low	Below average	Low to very low	Mixed
PRACTICE SIZE	Average to high	Above average	High	Below average	Low	High	Low
PATIENTS	Average	Average to high	High	Below average	Very low	Towards high	Mixed
TERRITORIES	7,20,21,25,52, 58,64,65,70	1,17,29,30,31, 33,35,36,38,57, 62	19,20,64,71	4,5,10,13,19,20, 24,27,30,41,46, 48,50,62,65,70	1,52	18!,30,75!	

Table 6..1 Macro-Analysis- The seven cluster solution

	Cluster 2		Cluster 3	
	Cluster 2A	Cluster 2B	Cluster 3A	Cluster 3B
	'Child Lover'	'Kinder-schreck'	'Initiators'	'Enthusiast'
LABEL	'Average to High Prescribers'	'High Prescribers'	'High to very high Prescribers'	'Very high Prescribers'
SIZE	17%	7%	4%	6%
SEX	Male above average	Male above average	Male!	Male!
AGE	1936-46, no younger	Older, no younger	1936-46, older	1926-36, older
INTERESTS	Cardiology, General Paediatrics, Obs. Gynae. Neonatology	Cardiology, General! No Paediatrics	Cardiology, Obs. & Gynae. Neonatology	General, Paediatrics, Dermatology
INNOVATIVE-NESS	Average	Innovative	25% Clinical Trials!	Innovative
NUMBER OF PRESCRIPTIONS	High to average	Average to high	Average to high	High!
PATIENTS SEEN	High	Average to high	High!	High!
REPS SEEN	Average to low	Average to high	Average to high	High
PRACTICE SIZE	High to exceptionally high	Mixed	Average to very high	Average to exceptionally high
PATIENTS RESPONSIBLE	Average to high	Average to high	Towards very high	High
TERRITORIES	1,6,17,25,30, 33,35,36,62	5		

Table 6.2 Description of cluster 2 and cluster 3

The Experiment

Or Average	17.5%
Early Majority	25.2%**
High Energy	18.5%
Young Conservative	13.1%**
Thrifty Housewife	19.7%
Odd Balls	10.5%
Quasi Homeopath	36.0%**

Response rate overall 19%.

** indicate differences significant at the 5% level

Table 6.3 Result of the experiment

HYPNOTICS (NHS)

	CLUSTER 1	CLUSTER 2	CLUSTER 3	CLUSTER 4	CLUSTER 5	CLUSTER 6
LABEL	Temazepam, Nitrazepam	"Do not"	Temazepam, Nitraze-pam, Triazolam	"Use many brands"	Temazepam, Triazolam	Nitraze-pam, Triazolam
SIZE	18%	17%	36%	19%	5%	6%
AGE	Older		1946-56 Younger	Older	1946-56 Younger	1926-36 Older
SEX		Male!			25% Female	25% Female
INTERESTS			Paedia-trics		Paedia-trics	Obs. & Gynae.Neo. General
INNOVA-TIVENESS	Common Use, Colleagues		Common Use!			
PRESCRIP-TIONS	Low-Average	Low	Average-Low	High	Low-Average	Low-Average
PATIENTS SEEN	Average!	Average-Low	High-Average	High-Average	Average!	Average-High
REPS SEEN	Low!					Average +
PRACTICE		Low			Average-Except-ional	Low
PATIENTS RESP.			Average	Average +	Average!	Average-Low
PRESCRIP-TIONS IN CLASS	Low-Average	41% Do Not	Average-Very High		Low-Average	Low
MACRO x MICRO	1,2A,4 Average	5,6,7 Low	1,2A,2B, 3B Higher	3A,3B Very High	1,4 Average-	1,2B,3B Average +
TERRI-TORIES	7,14,20, 24,52,58	1,4,5,7,8, 18,19,28, 30,40,46, 64,65,75	10,11,14, 36,37,38, 41,45,48, 57,58,62, 65,70,71	4,5,6,8, 17,28,24, 35,36,52, 61,71,75	11	18,29,37

Table 6.4 Micro-Analysis - Hypnotics

HYPNOTICS (NHS) Contd.

	CLUSTER 1	CLUSTER 2	CLUSTER 3	CLUSTER 4	CLUSTER 5	CLUSTER
LABEL	Temazepam, Nitrazepam	"Do not"	Temazepam, Nitraze-pam, Triazolam	"Use many brands"	Temazepam, Triazolam	Nitraze pam, Triazol
SIZE	18%	17%	36%	19%	5%	6%
AMYTAL				Other		
HEMINEVRIN	Popular		Other	Other		
NEMBUTAL				Other		
NITRAZEPAM	36% First 95% Use	Other!	25% First All Use	32% First 90% Use	Do not	48% Firs 93% Use
SODIUM-AMYTAL				Other		
SONERYL				Other		
TEMAZEPAM	58% First 98% Use	50% Other	61% First All Use	45% First 96% Use	75% First 100% 1.+2.	Not!
TRANCOPAL						Popular
WELLDORM	23% 3.		Other	Other		
CHLORDIA-ZEPOXIDE				Popular		
OXAZEPAM				Popular		
SOMINEX						
TRIAZOLAM	Do not!	Other	75% 2.+3.	Popular	18% First 96% Use	27% Firs 58% Use

Table 6.4 contd.

Chapter 7 Model Foundation

7.1 Introduction

The previous chapters have outlined the general area of decision support in marketing problems and discussed the specific example of a company in the pharmaceutical industry. The need for market segmentation was noted, and approaches to market segmentation were discussed (chapter four). As outlined in chapter five, response based segments could not be identified considering the data available. However, the segments determined by a static basis in chapter six demonstrated evidence for differences in response to marketing stimuli. Therefore it was concluded that the segments derived on the basis of a static analysis represented a meaningful way of describing market phenomena.

This chapter aims to take the analysis further by examining the consequences of market segmentation: the subsequent allocation of resources to the segments identified. The objective of this thesis is to test hypothesis H5, which states that:

> It is possible to develop a model assisting in the optimum allocation of the marketing budget to products, segments and promotional tools.

This chapter provides the background for testing this hypothesis. The results are discussed in chapter eight. Background will be discussed by relating the problem to be solved to approaches documented in the literature. While chapter two gave an overview of how the work reported here fits in with research into decision support systems, the emphasis here follows on more specifically by focussing on models and their parameterisation.

Following Piercy's (1987) distinction between the prescriptive approach to budgeting problems and the process orientated approach, this work's focus is clearly on the former. The prescriptive approach based on management science techniques is also reflected in the way the term decision support systems was used in chapter two, namely closely related to model building.

Clearly, Piercy is drawing attention to an important area which has received relatively little attention in the literature, the implementation of budgeting decisions. The two approaches, however, should not be seen as mutually exclusive. Although it is crucial to understand the process of implementing budgeting decisions, there is still room to build better models which, when successfully implemented, will hopefully lead to better decisions.

As discussed in chapter three, marketing expenditure in the pharmaceutical industry is restricted by the government via the PPRS to not exceed nine percent of sales. Hence, the marketing budget is usually more restricted than in many other industries. Within these restrictions, it is of paramount importance to employ the limited resources to best effect. As outlined in chapter three, sales force, direct mail and advertising are the three dominant areas of the promotional mix in the pharmaceutical industry. The sales force, accounting for 44% of promotional expenditure (ABPI, 1986), is the dominant tool. A model assisting in the allocation of the marketing budget, however, needs to include all these three elements of the promotional mix.

The second section in this chapter reviews the literature on models available to assist in decisions in the relevent areas for this thesis, namely advertising, marketing mix, and the sales force. The third section looks at approaches to parameterisation, with particular emphasis on the application of subjective estimation. The final section is dedicated to a summary which will be the basis for the application to be discussed in the following chapter.

7.2 Review of specific MDSS

Naert and Leeflang (1978, p.119) distinguished three purposes or intended uses for models:

1. Descriptive models.
2. Predictive models.
3. Normative models.

Descriptive models are used to describe decision processes with the aim of making these decision processes more explicit or to explore ways of improvement. Clearly, this application is not at the centre of the problem discussed here. Predictive models, however, aim to forecast future events. This is of interest here but these models do not prescribe what to do. Normative or prescriptive models achieve exactly that. Their purpose is the determination of an optimal policy in the light of a given objective such as sales or profit maximisation. Therefore, the emphasis of these models is very much geared toward action and decisions. This class of model serves to allocate resources optimally.

According to the requirements of modelling the allocation of the marketing budget to segments, products and media, the literature on marketing models has been reviewed. Models describing buyer behaviour or environmental developments can be left out of the review since these follow the descriptive rather than the prescriptive approach. It is more appropriate to review what Lilien and Kotler (1983) call 'Micro-marketing Decision Models', which study individual elements of the marketing mix.

They list as areas for micro-marketing decision models:

- product decisions
- advertising
- distribution
- price
- promotion
- sales force issues.

Of this list only the models related to advertising, sales force issues and promotion are applicable. Further analysis of models in the area of promotions reveals (Lilien and Kotler 1983, p. 534) that they are used to determine size of incentive, conditions for participation, distributor vehicle, duration, timing and the overall budget. Apart from the question of budgeting, no other area is of interest in this case. Since rates for advertising budgeting can easily be applied to direct mail (the only vehicle for sales promotion of interest in this case), sales promotion models are left out of the review.

Thus the focus of the review is on advertising models, sales force models and on marketing mix models which deal with the inter-action of the elements of the marketing mix. Before a review of specific models is undertaken, the next section highlights some of the issues tackled in models for advertising, sales force and marketing mix decisions.

Advertising DSS

Three different decision areas for advertising can be distinguished (Lilien and Kotler 1983, p. 485). Objective setting and budgeting are addressing problems such as how much to spend. Secondly, in copy decisions the message itself has to be evaluated. Thirdly, decisions on the type of media to be used have to be made. All these decisions are highly inter-related.

The effects of advertising have for long been debated, primarily because advertising accounts for the majority of promotional expenditure in consumer markets, hence it has high 'visibility'. Little (1979b, p.631-632) identified three major areas for controversy in advertising modelling: shape, dynamics and inter-actions.

a) Shape. By shape is meant the shape of a curve showing sales response to advertising. Here the debate is whether the relationship sales/advertising is linear, S- shaped or a different pattern. What are the sales with zero advertising?

b) Dynamics. Here the question is how fast sales respond to an increase in advertising. Also the rate of decay for a decrease in advertising, the question of whether a hysteresis effect (same level of sales following a withdrawal of advertising) can be expected and the problem of a change in effectiveness over the time period.

c) Inter-actions. The controversy is whether to advertise when sales are low or vice versa. Also the debate about the kind of inter-action with effects of other marketing variables (additive, multiplicative, or more complicated) is mentioned.

Marketing-Mix Models

Marketing-mix models are concerned with product, place, promotion and price. The problems of an inter-action of these variables have been discussed in section 2.2. Nevertheless, there have been trials to include all the decision variables in one model. Lilien and Kotler, (1983 p.663) define the following features for a marketing-mix model:

1. Allow for inter-actions among marketing-mix elements in general.

2. Permit advertising to increase or decrease price sensitivity.

3. Permit price to increase or decrease price sensitivity.

4. Permit positive or negative interactions among promotional vehicles.

5. Permit varying effectiveness over time and across market segments.

6. Incorporate advertising/selling interactions that are positive and that include order effects.

7. Incorporate advertising and promotional effectiveness explicitly.

8. A good marketing-mix model should incorporate competitive effects.

These requirements are difficult to meet and just a few models incorporate most of them. As one example Brandaid (Little 1975) is included in the list of models examined here.

Sales Force Decision Models.

Sales force decision models typically consist of two major structural components; a representation of market behaviour and an allocation technique (Laforge and Cravens 1980, p.245).

Cravens (1979 p.310) identified three key sales force resource decision areas:

(a) Determining the size of the sales force.

(b) Allocation of sales people to appropriate work units (e.g. territories, products, customers, etc.).

(c) Deployment of a salesperson's effort within the assigned work unit (e.g. among customers).

The response of the market to alternative levels of selling effort can be measured and expressed in various terms including (1) sales volume; (2) the change in sales volume; (3) the change in buyer awareness and attitudes; (4) the probability of favourable buyer reaction such as continued patronage or conversion from prospect to customer status; and (5) profits (Lambert and Kniffin 1970, p.3).

Comer (1979 p.344) noted that the result of attempts to model sales force problems is a series of models which have decomposed a sales management problem without a basis for linking them together again.

(a) Models for sales force size.

In trying to optimise the industrial sales force, Meidan (1982, p.65) identified three major difficulties:

- Working with historical data for future decisions.

- The problem of identifying the right factor to be maximised; i.e. profits, sales or return on investment.

- Many sales-oriented firms fail to realise that the individual salesperson is just one important factor in the marketing-mix.

He then identified five methods available to a firm optimising the sales force size.

1. Method developed by Fogg and Rokus (1973):

   This is a quantitative method for deciding between various selling methods, choosing the number of sales agents and management structure required. This is applicable if profitable sales are the required objective of the company.

2. The "vaguely right" approach (Lodish 1974) is applicable when a large company is dealing with numerous accounts. Then subjective data often need to be used.

3. Simulation enables a number of variables in different combinations to be taken into account.

4. The dynamic approach intends to model the changeable interaction of the selling effort.

5. Return on time invested (ROTI) could be used for control purpose applied in a large company with autonomous units.

As can be seen from the review discussed in the next section, decisions on the sales force size were among the first decisions to be modelled. Many trials were undertaken to use management science techniques such as linear programming or more sophisticated techniques to solve the problems.

(b) Allocation of sales people to work units

Models for the allocation across customers, territories, and products have been distinguished.

(b1) Models for allocation across customers

The models help in assessing the time that has to be spent with a customer or with prospects. These models usually assume the situation of a fixed sales force size and fixed territories. Since in many markets sales forces are organised by products, models usually cover one product.

Depending on the type of market, some models provide very detailed assistance, i.e. in the allocation of salesmen to accounts on the basis of individual competence. Some models take the perspective of a single salesman, while other models assist on an aggregated level.

(b2) Models of territory response

Sales in a salesperson's territory can be conceptualised as being a function of eight classes of variables (Ryans and Weinberg 1979, p.454): (1) environmental factors; (2) competition; (3) company marketing strategy and tactics; (4) sales force organisation, policies and procedures; (5) field sales manager's characteristics; (6) sales-person's characteristics; (7) territory characteristics; (8) individual customer factors.

One component of the sales territory alignment problem is the problem of how to aggregate in the best way small geographic building blocks, called standard geographic units (SGUs), into reasonable sales territories. A firm aligning sales territories according to sales potential, actual sales, workload, number of accounts or key accounts, etc. will need the appropriate actual or forecast data for each SGU (Zoltners 1979, p.361).

(b3) Models of sales effort allocation across products

Often a sales force handles a range of products, as it is the case in the pharmaceutical industry. The objective is to allocate the sales effort across products to optimise the benefits to the company. These benefits are difficult to assess. The support of new products, for example, might assure long-term profitability but could neglect short-term profits.

In the pharmaceutical industry generally two approaches are taken to deal with the problem. An indirect way is to introduce a compensation plan according to requirements; the direct way is to allocate the effort via a 'sales programme' in which the sales manager determines which products have to be promoted. The 'sales programmes' can be changed much more easily than the compensation structure.

(c) Deployment of salesperson's effort within a work unit

Models developed for this purpose cover aspects like routing problems. Also the allocation to prospects or customers is an area of interest under this heading.

Review of different MDSS

The "heart" of a DSS is the model describing the underlying process in the real world. The relevant literature has been screened for models and DSS developed for the purposes outlined before, namely for advertising, marketing mix and sales force allocation. Particular emphasis is put on sales force models due to the sales force's important role in pharmaceutical markets. The result is summarised in the form of a matrix in Table 7.1.

The criteria for the review are the following:

(a) Reference refers to the source of information and additionally, if available, to the "brand" name of the model.

(b) Resource describes the element of the marketing-mix which is modelled.

(c) Entity describes the specific aspect of the resource which is modelled.

(d) Sales response examines the way in which the response to the use of a single resource is modelled. Here is described the kind of function representing the reality and additionally, to what extent subjective judgement is included.

(e) Search procedure classifies the processes used in order to gain an output. 'Optimal' solutions achieved due to the use of linear or dynamic programming and also 'good' results due to the use of heuristics are identified.

(f) Inter-relation refers to the incorporation of more than one element of the marketing-mix or the inclusion of other dimensions.

(g) Carry-over effects address the question as to whether efforts in previous periods have an effect in the actual period.

(h) Application looks at industries or markets for which an implementation is reported in the literature. This aspect was included to gain an idea of the environment that might be suitable for a specific system.

(i) Comment covers aspects that are worth noting in addition to the other aspects.

Lessons to be Learnt

The review of the literature reveals that there is no single model reported that would cover all the aspects required, namely the allocation of marketing budgets to segments, products and promotional tools. Closest are marketing mix models which intrinsically are very difficult to calibrate due to the complexities involved. However, the application of 'BRANDAID' developed by Little (1975) is close to the requirements here. The lesson to be learnt from that model is the application of subjective estimation as a way to parameterise the model. The review of advertising models does contribute much to the calibration or parameterisation of models. Here the discussion of the shape of the response function is valuable. Again, decision calculus applications (Little 1970) offer interesting starting points for this case.

Sales Force models are probably the richest source for inspiration, since many were actually developed for pharmaceutical markets.

Early models such as 'CALLPLAN' (Lodish 1971) and 'DETAILER' (Montgomery et al 1971) explicitly employ subjective judgement to parameterise the model. 'DETAILER' is applied to pharmaceutical markets in respect to sales force allocation to products. Hobday and Raeh (1977) report a slight modification of 'DETAILER' and its application in the British pharmaceutical industry.

Lodish (1980) built on his earlier work to allocate the available call time not only to products but also to segments, an important step forward with regards to the problem to be tackled here: the allocation to products, segments and promotional tools.

The review of the literature did not reveal the existence of a model catering for the requirements discussed in this case. However, those models which were related to these problems rooted firmly on the application of subjective estimation as a means of model parameterisation.

7.3 Parameterisation

In the model building process as outlined in chapter two, the specification stage is followed by parameterisation. This process is dependent upon the availability of data on which a model's parameters can be determined. In the case described here objective data, by definition, can not be available comprehensively. This is because the Company's decision makers have never worked under the assumption of allocating the resources to segments. The concept of segmentation was introduced to the company as the result of the work reported in the previous chapters.

However, managers have always been allocating resources to products and media; data and experience therefore existed for decision making with respect to allocating promotional expenditure to products and promotional tools, but not in respect to expenditure on segments.

Under the circumstances that objective data simply do not exist, Naert and Leeflang (1978, p.206) recommended the use of subjective estimation as the only way to parameterise a model. The purpose of subjective estimation is to elicit judgements from decision makers and to quantify them (Lilien and Kotler 1983, p.128). They claimed that this is not necessarily an inferior way of obtaining data compared to the collection of objective or 'hard' data. This is because decision makers will have made decisions based on their judgement implicitly throughout their working lives. Subjective estimation just calls for an explicit expression of decision makers' beliefs/intuition.

Saunders (1985) pointed out the danger in any subjective estimation is that intuition is dressed into an analytical technique. If the estimates are poor, so will be the results. However, the application of this technique still allows the building of models even when insufficient objective data are available. Moreover, subjective estimation forces the model builders and the decision makers to interact. This process can only enhance mutual understanding and can only be beneficial to successful implementation.

Lilien and Kotler (1983, p.129) added an additional advantage which is important to the case reported here: the quantification of beliefs helps pinpoint the extent and importance of differences among decision makers with respect to the decision problem. The decision makers are forced to quantify their beliefs and to defend their judgement. By questioning the assumptions underlying the judgements, new insights might be gained.

Having decided to apply subjective estimation to parameterise the model, the method of how best to obtain the estimation has to be determined. This has to be done with the objective in mind that eventually the estimates have to be transformed into a mathematical representation. Clearly, it is inappropriate to ask for a mathematical representation of the decision makers' beliefs, since this is definitely alien to their way of thinking.

The most favoured approach is one developed by Little (1970) who put forward five questions, the answers to which are subsequently converted into a response equation. These five questions are:

1. What is your market share percentage now? S1

2. What level of advertising is necessary to maintain market share? A1

3. What would the market share be next period if advertising were reduced to zero (Ao)? So

4. What would market share be next period if advertising were increased to saturation (Am)? Sm

5. What would the market share be next period if advertising were increased to 50% above maintenance rate (Am)? S3

Figure 7.1 shows graphically how these answers are used to sketch the shape of the response function.

Managers often find it more difficult to estimate effects as results of extreme actions. Therefore to estimate the ultimate market share achievable at saturation expenditure is probably less reliable compared with estimating the effects of more gradual increases around the familiar expenditure level.

Consequently, Saunders (1985) suggested an alternative to Little's approach by asking incremental questions about expenditure levels close to those experienced by the decision makers:

What is current market share? S1

What level of advertising is necessary to maintain market share? A1

What would market share be if advertising were changed by the following percentages:

- Increased by 20% (A1.20)? S1.20
- Increased by 40% (A1.40)? S1.40

- Decreased by 20% (A0.80)? S0.80
- Decreased by 40% (A0.60)? S0.60

The model builder can then convert the answers into a response curve using curve fitting techniques. This allows the application of general equations.

This issue then raises the more fundamental question of 'realistic' shapes of response curves. Saunders (1987) reviewed nine propositions with respect to the shape of the response function. His findings (C.F. figure 7.3 displaying likely shapes of response functions) for the various propositions were:

1. Effect zero when effort zero

This is intrinsically not true, although there is no theory for or against the case.

2. There is a linear relationship between cause and effect.

Although there is no evidence for or against this proposition, it is reasonable to assume that this proposition is not true at the extremes. For example, intuitively it would make sense to assume that with increasing market share an increasing disproportional effort is required to gain the final percentage points to gain one hundred percent share.

3. There are decreasing returns to scale with effort. As explained in the previous proposition, this phenomenon does make sense intuitively. Empirical evidence supports this proposition.

4. Saturation.
Apart from the logical constraints of market share models with the obvious upper limit of one hundred percent, it is difficult to find evidence for the existence of saturation levels.

5. There are increasing returns to scale with effort. This is only true within limits. Ultimately this proposition has to be rejected.

6. There are first increasing, and then decreasing returns to scale ('S-shape')
Intuitively, the increasing returns to scale followed by a decrease at a certain level of expenditure make sense, primarily in advertising. Evidence, however, for its existence is fairly limited.

7. Threshold effects.

The suggestion that marketing effort must reach a critical level (threshold) before it will have any effect at all is not supported by evidence and may be a monstrous myth.

8. Supersaturation

The existence of supersaturation, when sales decline as a consequence of excessive marketing effort is not supported by evidence.

The next issue to be solved is the decision to choose the mathematical expression to fit the data. Naert and Leeflang (1978, chapter 5.3.1) gave an overview of popular mathematical representations. Saunders (1987) provided a summary of expressions used in the literature which is detailed in table 7.1. As to the question which of the mathematical representations to select, Saunders concluded (1987, p 31) that no expression is ideal. This conclusion is founded upon analysis of testing the various expressions with respect to goodness of fit and shape. In selecting the mathematical expression he suggested the following five steps (Saunders 1987, p 31):

- (1) Determine the propositions that are critical to the operations of the model.

- (2) Select the most simple expression that makes the model robust in operation.
- (3) Estimate and validate the model.
- (4) If the fit is poor go back to step 2
- (5) If the fit is good, do not assume that the expression is the actual response function and be sceptical about the conclusions. In particular, question if the results are a function of the expression rather than the data.

In the case discussed in this thesis, the response to marketing stimuli must be modelled. If this response is to be measured in terms of market share, then the requirements for the mathematical expression of the response curve are that it should allow for saturation and for diminishing returns to scale or S- shaped response. Consequently the following models need to be taken into consideration for the application to be discussed in the next chapter:

- Modified exponential model
- Gompertz model
- Logistic model
- Decision calculus model

7.4 Summary

This chapter has outlined the foundation for the model to be developed, which in turn is discussed in the next chapter.

Following on from the literature review on decision support systems presented in chapter two, the emphasis in this chapter is on models assisting in decision making in the areas identified in chapters three to five, namely, sales force, advertising and marketing mix decisions.

The section reviewing marketing models describes the elements of decision making in the three mentioned areas, before models presented in the literature are reviewed. From this review it is concluded that there is a gap in the literature; no model could be detected which would cover the elements desired in the case described here. However, some important contributions were noticed which enable further development in order to accommodate the problems to be solved here.

In particular experiences with BRANDAID (Little 1975) and DETAILER (Montgomery et al 1971) and its applications in the UK pharmaceutical industry (Hobday and Raeh 1977) provide excellent starting positions for further development. None of these models, however, includes the allocation of resources to segments.

The common denominator of those models is that they all require the application of subjective estimation for parameterisation. Subsequently, some issues related to subjective estimation in parameterising models are discussed. The discussion focuses on two aspects, the process of subjective estimation - how best to obtain estimates from decision makers and how to translate these estimates into a response curve. Some techniques with respect to eliciting estimates from managers are presented. In particular, contributions by Saunders (1987) offer usable advice in applying subjective estimation. He suggested judgements for a response by phrasing questions in increments around a familiar spending level rather than expecting managers to estimate response to marketing stimuli at extreme levels of expenditure as suggested by Little (1971).

When translating the estimates into a response function, the shape of the response function is important. Propositions made in the literature with respect to realistic shapes of response curves are discussed. It is concluded that decreasing returns to scale and saturation, particularly important in market share models are features of realistic response curves.

These features are fulfilled by four types of models which are :

- Modified Exponential Model
- Gompertz Model
- Logistic Model
- Decision Calculus Model

These models have to be considered for the application to be described in the following chapter.

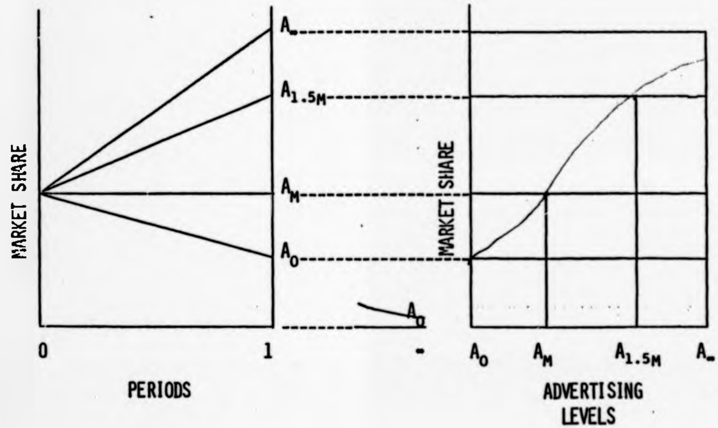


Figure 7.1 The response curve

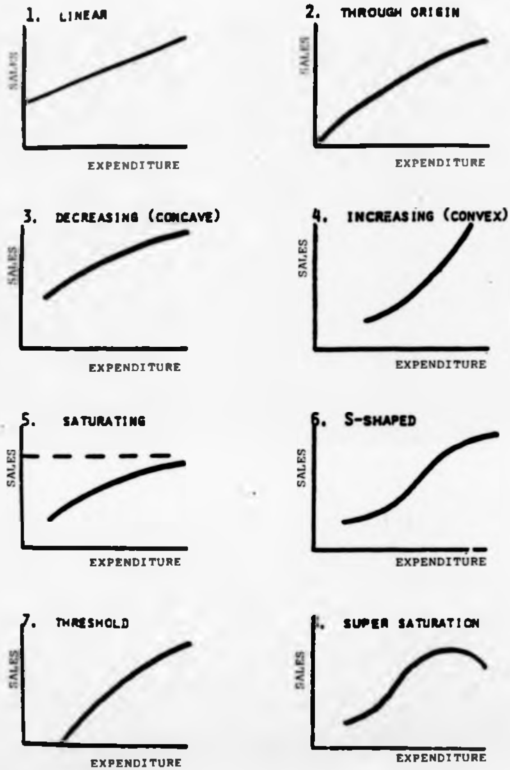


Figure 7.2 Shapes of response curves (adopted from Saunders, 1987)

Reference	Resource	Entity	Sales Response Function a) Functional Form b) Estimation	Search Procedure	Interrelation	Carry-over	Application	Comment
Layton 1968	Sales effort available to a sales team	Prospective customers	a) Discrete sales response functions resulting from a decision tree analysis b) Subjective judgement	Dynamic programming	No	No	High cost complex capital equipment - industrial markets	.suable if countable number of prospects
Little 1970 ADBUDG	Advertising budget	Time, amount	a) S-shaped b) Subjective judgement	Enumeration	Indirect; Promotion; Price; Competitive action through parameterization	Yes	Different Industries; consumer products	Recommended for Pharma industry (Kleinert 1982)
Davis/Farley 1971	Sales representative call time	products	Theoretical sales response function; twice differentiated, second derivative is negative	non-linear programming	No	No	Not reported	Using commissions and quotas to allocate sales force effort; Multi product line
Hess/Samuels 1971 GEOLINE	Sales force	sales territory	empirical data; Activity measure dependent on application	linear programming	No	No	Pharmaceutical Company (CIBA) Computer Company (IBM)	Starts with standard geographic units (SGU) Intends to equalize workload Activity measure Individual salesman; Equalize in terms of salesman's activity Size exogenous
Lodish 1971 Callplan	Sales representative call time	clients/ prospects	a) Logit function b) Subjective judgement	Optimal solution to approximate problem	Travel time; Time required per call; Account profitability; call frequency	No	In different industries. Useful for repetitive selling, where the amount of time spent with an account is important to sales	Salesman's perspective; Territorial boundaries given
Montgomery/ Silk/ Zaragoza Detailer 1971	Sales calls	products	a) Cubic response function and exponential forgetting function b) Subjective judgement	heuristic	No	Yes	American Pharmaceutical industry	Decision variable: relative exposure value Allows full/half/ quarter coverage; multi product line fixed size and territories

Table 7.1 Review of MDSS
(Based on Maier, 1985)

Reference	Resource	Entity	Sales Response Function a) Functional Form b) Estimation	Search Procedure	Interrelation	Carry-over	Application	Comment
Comer 1974 Allocate	Sales territory sales effort	customers/ prospects	a) Discrete Functions based on probability estimates b) Historical data; subjective judgement	Heuristic	could be used for sizing	No	Consumer product; Salesman calling on wholesalers and variety of direct retail outlets	restricted to one product
Tapiero/ Farley 1975	Sales representative call time	products	Theoretical sales response functions; concave; Forgetting function	Optimal control	No	Yes	not reported	Commission rates as a means of sales effort allocation to products; only one product; emphasis on control
Darmon 1975	Sales representative call time	customers/ prospects	a) Probabilistic function based on the linear learning model b) Subjective judgement historical data	Single-priced knapsack models	No	Yes		
Armstrong 1976 SCHEDULE	Sales representative call time	current and prospective accounts	a) Probabilistic function. modified exponential b) Subjective judgement	Nonlinear programming plus rounding to nearest integer	No	No	large temporary labour firm; 3 salesmen; limited application	perspective of a single salesman; no routing; receives optimal subjective judgement on potential
Lodish 1975	Sales representative call time	territories	a) Logit function b) Subjective judgement	mathematical programming Heuristic	call frequency	no	tests in large industrial products firm + 5 other firms	CALLPLAN used for determining call policy; One product; Does not guarantee optimality
Shanker/ Turner/ Zoltners 1975	sales effort	customers, territories	a) Concave piecewise linear approximation b) Subjective estimation Historical data	Integer programming	Variation in boundaries; effort to individual customer	No	Case study	One product; Which customers should be included in which territories; Intends to combine GEOLINE and CALLPLAN effects

Table 7.1 contd.

Reference	Resource	Entity	Sales Response Function a) Functional Form b) Estimation	Search Procedure	Interrelation	Carry-over	Application	Comment
Little 1975 BRANDAID	Marketing mix	Price Advertising Promotion Salesman effort	a) Multiplicative Indices b) Subjective parameter estimation	Heuristic	Marketing mix	Yes	Packaged goods; Consumer industry	Aggregate Response model Modular; problem of over-calibration
Lodish 1976	Sales time available to several sales representatives	Accounts	a) Concave piecewise linear approximations to non-linear functions b) Subjective judgement	Linear programming and rounding to integer solution	No	No	financial products to financial institutions; Media representatives in metropolitan areas	Each salesman estimates response for various numbers of hours spent with present customers
Beswick 1977	Sales time	Control units, territories	a) Class of multivariate response functions, primarily exponential b) Historical data Subjective judgement	Mathematical programming	Allocation sales effort to territory; Sizing	No	for high priced consumer good; salesforce calling on retailer	introduction of control unit
Beswick/ Cravens 1977	Sales force	Allocation of effort to territories; sales force size; Territorial design (Advertising)	a) Class of multivariate response functions; primarily exponential b) Historical data Subjective judgement	Mathematical programming	Allocating sales effort to territories; Sizing; Territorial design Advertising (indirect)	No	for high priced consumer good; salesforce calling on retailers	Multistage decision model: 1. Market response function 2. allocating selling effort and setting sales force size 3. Territorial design
Parasuraman/ Day 1977 PAIRS	Call time	Customer groups	a) Logit function b) Subjective judgement	Heuristic	Selling ability call frequency	Yes	Consumer goods	Customers formed to groups; Models customer-salesman interrelation; One product
Hobday/ Raeah 1977	Call time	products	Subjective judgement; forgetting function	Heuristic	No	Yes	British pharma industry	Successful implementation of DSS based on DETAILER concept; product manager's estimation; product class

Table 7.1 contd.

Reference	Resource	Entity	Sales Response function a) Functional Form b) Estimation	Search Procedure	Interrelation	Carry-over	Application	Comment
Fudge/Lodish 1977	Sales representative	Travel agents corporations	a) Logit function b) Subjective Judgement	Optimal solution to approximate problem	Travel time; Time per account; Profitability	No	Airline salesmen	Allocating salesman's effort to prospects and customers; CALLPLAN application
Glaze/ Weinberg 1979 TAPS	Sales representative's call time	clients, prospects	a) Modified exponential b) Subjective judgement	Combination of the algorithms found in Lodish (1971) and Luss and Gupta (1975)	locate sales-persons; assignment to accounts; allocate time to accounts	No	Case study	Builds on CALLPLAN GEOLINE
Zoltners/ Sinha/Chong 1979	Sales representative call time	clients, prospects	a) Arbitrary, discrete b) Arbitrary	Integer programming (Branch and Bound)	Flexible	No	Not reported	Framework for sales force decision models
Lodish 1980	call time	products and market segments	a) Logit function b) Subjective judgement	Optimal solution to approximate problem	Sales effort allocation products/ segments; Sizing	No	Pharma industry 3 companies including one using DETAILER	Decision variable is number of mentions per time period No dynamic aspects; Response functions for each segment
Blattberg/ Jeuland 1981	Advertising	Sales	Exposure process follows Bernoulli process	Regression	Reach of ads decay of effectiveness	Yes	Not reported	reach of ads and rates decay; single product; Micro model at individual level then aggregated over time and across individuals
Sinha/ Zoltners 1981	Sales effort	Market and products	a) Discrete profit response function for each product-market combination b) Survey data Subjective judgement	Integer programming (branch and bound)	No	No	Large US firm	Product mentions combined to sales calls

Table 7.1 contd.

Reference	Resource	Entity	Sales Response Function a) Functional Form b) Estimation	Search Procedure	Interrelation	Carry-over	Application	Comment
Holthausen/ Assmus	Advertising budget	Segments or territories	Probability distribution exponential response	Mathematical programming	Other marketing variables could be included in response function	No	Not reported	Introduction of efficient frontiers for different profiles; Portfolio approach
Broadbent 1984 ADSTOCK	TV - Advertising	Ad Awareness; Recall	a) Linear logorithmic or geometric b) Regression	Regression	No	Yes	Study with 120 brands	Linear model is as good as others

Table 7.1 contd.

Type	Expression	Users
Linear		
Simple	$Y = a + bx$	Carman; Lambin
Squared	$Y = a + bX^2$	Frank'
Square root	$Y = a + b\sqrt{X}$	Naert and Leeflang; Winer
Reciprocal	$Y = a + b^1/x$	Naert and Leeflang
Polynomial	$Y = a + bX \ldots b_nX^n$	Little
Log linearisable		
Semi-log	$Y = a + \ln X$	Lambin; Carol, Green and De Sarbo
Exponential	$\ln Y = a + bX$	Parsons; Wierenga
Log reciprocal	$\ln Y = a + b/X$	Brown and Tucker
Log-log	$\ln Y = a + b \ln X$	Lambin; Ryans and Weinberg
Not linearisable		
Gompertz	$Y = ab^{c^X}$	Naert and Leeflang
Modified exponential	$Y = a(1 - \exp(-bX^c))$	Little and Lodish; Simon
Logistics	$Y = a/(1 + \exp(b + cX))$	Naert and Leeflang
Zentler and Ryde	$Y = a \dfrac{(X/b)^2}{1 + (X/b) + (X/b)^2}$	Benjamin and Maitland; Zentler and Ryde
Little	$Y = a + (b-c) \dfrac{X^d}{e + X^d}$	Little
Johansson	$Y = \dfrac{a + bcX^d}{1 + cX^d}$	Johansson

Table 7.2 List of mathematical expressions of response curves (as compiled by Saunders, 1987)

Chapter 8 RESOURCE ALLOCATION - THE APPLICATION

8.1 Introduction

Based on the literature reviews presented in chapter seven, this chapter now outlines an application of a resource allocation model. Specifically, hypothesis H5 is tested which states that:

> It is possible to develop a model assisting in the optimum allocation of the marketing budget to products, segments and promotional tools.

The products to be included in the model cover the portfolio of the company described in chapter three and include five products at different stages of their respective product life cycles.

As discussed in chapter three, marketing expenditure in the pharmaceutical industry is restricted by the Government via the PPRS to not exceed nine percent of sales. Hence, the marketing budget is usually more restricted than in many other industries. Within these restrictions, it is of paramount importance to employ the limited resources to best effect. As outlined in Chapter three, sales force, direct mail and advertising are the three dominant areas of the promotional mix in the pharmaceutical industry. The sales force, accounting for 44% of promotional expenditure (ABPI, 1986), is the dominant tool. A model assisting in the allocation of the marketing budget, however, needs to include all three elements of the promotional mix.

Segments in this context are those identified in the macro-analysis presented in chapter six. These seven segments comprise 'Dr Average', 'Early Majority', 'High Energy', 'Young Conservative', 'Thrifty Housewife', 'Odd Ball', and 'Quasi Homeopath'.

The second section in this chapter specifies the model to be used. The third section covers estimation and fitting of the model. The fourth section describes the optimisation procedure. The fifth section discusses the results achieved via the optimisation. The sixth section summarises validation procedures. The final section is dedicated to a summary.

8.2 Model Specification

In terms of the model building process outlined in chapter two, the previous chapters have discussed in detail the stage of problem finding, namely the allocation of the marketing budget to products, segments, and promotional tools. This section is now concerned with the determination of the model development criteria as well as the actual model building.

Having decided upon the class of model, the variables to be included have to be selected. The dependent variable chosen is gross profit, since profit is often the ultimate objective in business. In the case reported here the real profit figures might not even be known to the marketing decision makers. This is due to some technicalities specific to multinationals which include issues such as transfer pricing. Gross profit, however, is the objective according to which the marketing manager's performance is judged - hence the choice as the dependent variable.

The next section outlines the process of developing a model measuring the gross profit across products, across the segments identified in chapter six as a function of promotional expenditure on tools such as sales force, direct mail and advertising.

Gross profit can be expressed as

E 8.1 $GP = GM \times SALES$

with GP Gross Profit

GM Gross Margin

SALES Total Sales

Total Sales however can be expressed as

E 8.2 $\quad SALES = SHARE\ (X) \times SIZE$

with

SHARE (X)	Market Share as a function of promotional expenditure X
SIZE	Market Size

Thus, equation E 8.1 can be rewritten as

E 8.3 $\quad GP = GM \times SIZE \times SHARE\ (X)$

With the introduction of a number of products p (p = 1...P), the gross profit equals the sum of gross profits for individual products. Thus, equation E 8.3 can be written as:

E 8.4 $\quad GP = \sum_{p=1}^{P} (GM_p \times SIZE_p \times SHARE_p\ (X_p))$

When the model is further developed to cater for different segments s (s = 1...S), sizes and shares will vary in the market segments. The gross margin, however, is assumed to be fixed for a product across segments. Thus, equation E 8.4 is further developed to:

E 8.5 $$GP = \sum_{p=1}^{P} GM_p \times \sum_{s=1}^{S} (SIZE_{p,s} \times SHARE_{p,s} (X_{p,s}))$$

In this equation the market share is expressed as a function of promotional expenditure X. This expenditure X comprises the sum of the expenditure on sales force, direct mail and advertising. To allow for the interaction of the elements of the promotional mix m (m = 1...M) in their effect on market share in a market segment, market share can be expressed as:

E8.6 $$SHARE_{p,s} (X_{p,s}) = SMAX_{p,s} - ((SMAX_{p,s} - SNOW_{p,s}) \times \prod_{m=1}^{M} ((MSMAX_{p,s,m} - F_{p,s,m} (X_{p,s,m})) / (MSMAX_{p,s,m} - SNOW_{p,s})))$$

with

SMAX	Maximum Market Share in a Segment
SNOW	Current Market Share in a Segment
MSMAX	Maximum Market Share available in a Segment due to the effect of a single Medium.
F	Response Function measuring Market Share as a function of expenditure on a particular Medium.

Thus, equation E 8.6 states that the market share for a product in a particular market segment cannot exceed SMAX, the maximum market share. The effects of the interaction of the promotional tools is catered for by the multiplicative term in the equation. This term is in turn dependent on the response functions which measure the achievable market share as a function of a single promotional tool. When equation E 8.6 is substituted into equation E 8.5, the final version of the model is developed.

E 8.7
$$GP = \sum_{p=1}^{P} GM_p \times \sum_{s=1}^{S} (SIZE_{p,s} \times SMAX_{p,s} - ((SMAX_{p,s} - SNOW_{p,s}) \times \prod_{m=1}^{M} ((MSMAX_{p,s,m} - F_{p,s,m}(X_{p,s,m})) / (MSMAX_{p,s,m} - SNOW_{p,s}))))$$

where

GP	Gross Profit
GM	Gross Margin
SIZE	Market Size
SMAX	Maximum Market Share in a Segment
SNOW	Current Market Share in a Segment
MSMAX	Maximum Market Share available in a Segment due to the effect of a single Medium.

F Response Function measuring Market Share as a function of expenditure on a particular Medium.

The ceilings SMAX and MSMAX in equations E8.6 and E8.7 prevent the model predicting market shares which exceed 1 (i.e. 100%). However, rather than using 1 as the ultimate ceiling for market shares available it is more realistic to assume an upper ceiling which is based on the current market shares. This is especially important in the case of products with a low current market share for which a dominant market share in subsequent periods is often unrealistic.

In the model the difference between the current market share and the ceiling forms the basis for measuring the impact of promotional effort. The multiplicative term in the equation determines the effect of promotional effort. If, for example the response functions $F_{p,s,m}$ all equalled the value of the current market shares $SNOW_{p,s}$, then the multiplicative term would amount to one, hence the predicted market share would not change compared to the current market share.

The use of multiplicative representations is widely used in marketing (Lilien and Kotler 1983, p.73). In particular interaction effects can be well captured as Naert and Leeflang (1978, p.74) observed.

Here, the interaction of the promotional tools is realised in the multiplicative term, which for each of the tools calculates a factor around 1. By multiplying values around 1 the result of the multiplicative term in turn is around 1. A value for the multiplicative term greater than 1 indicates that the predicted market share will be smaller than the current market share. Obviously, the opposite is true for values smaller than 1, which would indicate a rise in market share.

The model as described in equation E8.7 is robust in that it does not allow for market shares to exceed 1. It is also logically consistent in that it accounts for interaction between the tools of the promotional mix.

8.3 Parameterisation

In the model building process as outlined in chapter two, the specification stage is followed by parameterisation. This process is dependent upon the availability of data on which a model's parameters can be determined. In the case described here objective data, by definition, can not be available comprehensively. This is because the Company's decision makers have never worked under the assumption of allocating the resources to segments. The concept of segmentation was basically introduced to the Company as the result of the work reported in the previous chapters.

However, management has always allocated resources to products and media; data and experience therefore existed for decision making with respect to allocating promotional expenditure to products and promotional tools, but not in respect of expenditure to <u>segments</u>.

As explained in the previous chapter, in the absence of hard data it is appropriate to apply subjective estimation. Therefore a framework was established which enables to obtain the best possible quality of estimates. This had to be done with the intention to eventually transform the estimates into a mathematical representation. As discussed in the previous chapter it is clearly inappropriate to ask for a mathematical representation of the decision makers' beliefs, since this is definitely alien to their way of thinking.

The Saunders (1987) and Little (1970) approaches were combined in this case. Of the five products for which the model was to be developed, three were established, while one was a newly launched product. The fifth product was an old one but with no recent history of promotional activity. The company, in the absence of its new star product which became a victim of the limited list (chapter three), decided to promote this well established product again.

It was found, however, that the methods described for estimating response to marketing stimuli as discussed in the previous chapter did not fit the requirements of all the cases which had to be tackled. For example, for an established product there is usually no problem in establishing current market share. In addition it should not be too difficult to estimate the required level of expenditure to maintain that market share.

However, in the case of a new product the current market share will be close to zero. The corresponding maintenance expenditure is obviously close to zero as well. Thus, any estimate of market share as a function of multiples or even fractions of the maintenance level inevitably neglects the projected growth in market share. The use of the maintenance level as a reference is clearly inappropriate.

In this case a much better reference seems to be the <u>budgeted</u> level of expenditure and the forecast market share. Managers will have made the original budgeting decision with a certain objective in mind, which is usually closely related to market share. Use of this figure as a reference point will enable the most accurate estimation of expected market shares as functions of fractions or multiples of this reference expenditure.

Consequently, the questions are amended to fit the case of an established, mature product with no recent history of promotional expenditure as well as that of a new product. These questions are outlined in table 8.1. For the established products, the Saunders approach was taken with the questions listed in table 8.2.

The estimation of response to promotional expenditure was carried out in a workshop with relevant marketing managers of the company and two model builders acting as catalysts. Present were the marketing director, who in twenty years with the company had been brand manager for most of the products in question. The current brand manager for three of the five products was also present. He also had experience as a brand manager of the other products. The third participant was the market research manager, usually in charge of monitoring promotional expenditure in the market place and its effect on market shares. The brand manager in charge of the remaining products, who had only recently been appointed, was unable to attend the workshop due to other commitments.

The first part of the workshop was held outside the company's premises. A full day was spent on the estimation of the first three products. The same time was spent with the same group of people to estimate the other two products, on the company's premises. All parties involved agreed that a workshop held off the company's premises is much more productive due to fewer interruptions.

It was decided to focus attention on the five most attractive segments with respect to size and significance, namely 'Dr Average', 'Early Majority', 'High Energy', 'Young Conservative', and 'Thrifty Housewife'. The 'Odd Ball' and 'Quasi Homeopath' were excluded from the analysis.

But even then the estimation exercise had to cover in total five products, five segments, and three promotional tools. Since advertising cannot be targeted down to a segment level as obviously direct mail and sales force effort can, the response to advertising expenditure for the five products was only estimated at the unsegmented level, by treating the market as one big market. This meant that five advertising response curves and twenty-five response curves for direct mail and sales force expenditure respectively had to be estimated.

By having to estimate in total fifty-five response curves mainly on a segment basis, an interesting side-effect could be observed. The profiles of the segments were re-inforced. For the first time the decision makers were forced to view actively the market not as one big single market but as a sum of a number of segments. Particularly helpful were the labels allocated to the segments such as 'Dr Average' or 'Young Conservative'. These labels helped enormously to bring the segments to life and they enhanced considerably the ability to imagine the segments' characteristics.

At the time of the estimation the budget was not allocated to segments; it was allocated to products and the promotional tools only. When estimating the response to expenditure on a segment basis, the amount allocated to a segment was calculated as the budgeted level of expenditure in proportion to the size of the segment in question. For example, if total budgeted expenditure for sales force for a particular product totalled £100 K, then the allocation to 'Young Conservatives' (who account for 28% of the market) was calculated as £28,000.

With the help of a Lotus 1-2-3 spreadsheet the answers to the questions were easily converted into a graphical form. This graphical representation was then assessed by the decision makers in terms of whether this response curve represented a realistic relationship. This often initiated an interactive process which led to adjustments to the answers to the questions.

As far as the shape of the response function is concerned, in this case decision makers' experience indicated the existence of saturation as a plausible form of response in the short run. Depending on the product/market situation the existence of diminishing returns or S-shaped response was acknowledged.

Data were subsequently obtained in the workshop by going through an iterative process of estimating the response, plotting the results, adjusting the estimations, etc.

The next issue to be solved was the decision which curve to choose to fit the data. The characteristics of the curves as plotted required the mathematical expressions to allow for saturation and, preferably, the market share of greater than zero at zero expenditure. With these characteristics clearly the exponential model, linear model (no saturation), or quadratic models (supersaturation) do not fit the requirements. Consequently, four models were taken into consideration (figure 8.1):

- Modified exponential model
- Gompertz model
- Logistic model
- Decision calculus model

The modified exponential model is intrinsically a non-linear model. However, once the saturation level alpha O is known it can be estimated using regression analysis. Although the R^2 values are reasonable, the drawbacks in using this model are twofold: first it assumes no market share at no expenditure, and secondly it has not the ability to display S-shaped behaviour.

The logistic model again can be estimated once alpha O is known. This model does allow for s-shaped behaviour and a positive market share at no expenditure. However, the R^2 values are not as good as in other models (Saunders, 1987). Moreover, using the equation in an optimisation procedure, the application or at least the first-order derivatives are required. The rather complicated form of the equation seems to make life unnecessarily difficult.

The same argument applies to the decision calculus models, which obviously make an optimisation procedure unnecessarily more complicated. In particular it is very difficult to parameterise the model with the approach taken in this case. The three other models can be parameterised using regression analysis once a few simple logarithmic transformations are made. The complicated mathematical structure of this model prohibits taking this approach. Thus, the decision calculus model was rejected in this case.

The Gompertz model by comparison is easily transformable into a format which allows it to be parameterised using regression analysis. The Gompertz model can be used to express market share S as a function of promotional expenditure X.

E 8.8 $$S = \alpha_0 * \alpha_1 ** (- \alpha_2 ** X)$$

After a few transformations equation E 8.7 can be rewritten as:

E 8.9 $$\ln (- \ln (S / \alpha_0)) = A + B * X$$

with $A = \ln \ln \alpha_1$

$B = \ln \alpha_2$.

This model was easily parameterised using regression analysis and it displayed high values for goodness of fit (R^2) yet showed the desired features without being too complicated. A selection of cases was fitted to all three curves, leaving the decision calculus model out, as is demonstrated in examples displayed in figures 8.2 to 8.4 representing the estimates of sales force expenditure in segment 'Early Majority' for product Dalacin.

Because the Gompertz model showed not only superior R^2 values, but also displayed the requirements best, i.e. S-shape and shares greater than zero at zero expenditure, it was chosen to represent the managers' estimates. In addition the shape followed most closely the data as estimated by the managers. Therefore a compromise was found between the desire to be as accurate as possible and the ability to parameterise a model best.

Subsequently, all fifty-five response curves were fitted to the Gompertz model. Table 8.3 provides an overview of the raw data created inclusive of R^2 values.

8.4 Optimisation

The worked example of the optimisation procedure addresses a problem of the optimum allocation of the marketing budget across five products, across five relevant segments ('Dr. Average', 'Early Majority', 'High Energy', 'Young Conservatives' and 'Thrifty

Housewives') and across three media (sales force, advertising, and direct mail).

The optimisation problem is then to maximise gross profit according to

E 8.10 $$\text{Max } GP = \sum_{p=1}^{3} GM_p \times \sum_{s=1}^{5} (SIZE_{p,s} \times SHARE_{p,s}\ (x_{p,s}))$$

with

E 8.11 $SHARE_{p,s}\ (X_{p,s}) =$

$$SMAX_{p,s} - ((SMAX_{p,s} - SNOW_{p,s}) \times \sum_{m=1}^{3} ((MSMAX_{p,s,m} - F_{p,s,m},(Xp,s,m))/ (MSMAX_{p,s,m} - SNOW_{p,s})))$$

Subject to

E 8.12 $$\Sigma\ X_{p,s,m} = B$$

B the available marketing budget

all $X_{p,s,m} \geq 0$

Since advertising can not be channelled to individual segments, expenditure on advertising is treated as <u>total</u> advertising expenditure across segments. Hence the model contains fifty-five variables.

This optimisation problem can be described as constrained and non-linear (Beightler et al 1979). The complex structure of the problem in this case means that analytical derivatives are not available, making the choice of the appropriate optimisation routine more difficult.

However, a transformation (c.f. FORTRAN programme in appendix 2) allows to view this problem as an unconstrained problem. This approach offers the advantage of the application of an easy to use quasi-Newton algorithm as introduced by Gill and Murray (1972). This algorithm is implemented in the NAG routine E04 CGF.

The optimisation procedure is conducted using the NAG routine and utilising the computer language FORTRAN. An example of the full programme developed is displayed in appendix 2.

The following is read in:

- <u>Gross Margin</u>, data on the respective gross margin by product.
- <u>Market Size</u>, data on the monetary value of each market segment for each product.
- <u>Current Expenditure</u>, data on current expenditure for each product by segment and medium. This

information allows the initial start of the optimisation procedure.

- <u>Current Market Share</u>, data on the current market shares for products in each of the five segments.
- <u>Coefficients of Response Curves</u>, data on the coefficients of the individually estimated response curves.
- <u>Maximum Market Shares</u>, data on the highest realistically achievable market share for each product in each segment.
- <u>Achievable Market Shares</u>, data on the highest realistically achievable market share for each product in each segment with the sole use of <u>one</u> particular medium.

8.5 <u>Results and Discussion</u>

The results of the optimisation procedures are displayed in table 8.4. The model calculates a gross profit of £4.021 million with a current allocation of the fixed marketing budget. This compares with a gross profit figure of £6.507 million if the allocation is completely unconstrained. An increase of more than 50% in gross profit is indicated by re-allocating the marketing budget.

The optimum allocation shows a strong shift away from the utilisation of the sales force in favour of increasing use of advertising and direct mail. A cut in the expenditure on sales force from £1 million, representing 66% of total promotional expenditure is probably expected since this level is well above the industry's standard of 44%. However, a suggested level of spending at £100,000 amounts to a tenfold decrease. This is such a strong cut that it is basically questioning the conventional wisdom in the industry which states that the sales force is the most powerful promotional tool.

This result might therefore reflect the under-estimation of the effect of the sales force and an over-estimation of the effectiveness of direct mail and advertising by the marketing managers when estimating the response to marketing expenditure. In particular the findings reported in chapter five which suggest an less effective role of promotion in gaining new customers should be taken into account. These findings call for further investigation, for example with the use of time series data and econometric models. The results of this investigation should then be used to verify the estimates used here.

The low level of expenditure for the sales force postulated by the results reported here might be a very strong strategic indicator in the long run, but in the short-term expenditure on the sales force is fairly fixed.

Obviously expenditure on direct mail or advertising can be adjusted as and when required. When deciding on sales force expenditure the company has to take a number of considerations into account which are not easily quantifiable. Apart from the question whether it is possible to adjust the number of representatives in an ad-hoc manner, it is the more general problem of dealing with people to whom the company might feel a degree of loyalty which would actually prevent any drastic short-term measures.

If one accepts that as far as the sales force is concerned the company's flexibility is somewhat limited, the model needs to take this into account. This results in the extension of the optimisation procedure to provide for additional constraints. In this case the optimisation procedure can be run at various levels of constraints expressed as fractions of current expenditure levels. At the extreme the optimisation can be run under the constraint that no reduction in sales force expenditure is possible. The result of this is displayed in table 8.5.

The result indicates a slight drop in profits achievable compared to the unconstrained solution.

Probably, the most realistic version is the result displayed in table 8.6. This is achieved using a limit of 80% of sales force expenditure. A gross profit in excess of £6.2 million is not too different from the results of the unconstrained solutions.

Overall, it is obvious that considerable improvements in gross profits are achievable by re-allocating the marketing expenditure. Although the unconstrained solution suggests a significant cut in sales force expenditure, results at certain fixed levels of sales force expenditure are still significantly higher than is currently achievable, and the results are still within five to ten percent around the optimum solution.

8.6 Validation

The results discussed in the previous section must be validated. One area to be checked is the proneness to depend too closely on the starting position. As explained in section 8.4 the initial starting data used comprised the current expenditure on products and media, whereby the expenditure by segment was calculated on the basis of being proportionate to the size of the segment. By re-allocating the budget a gross profit increase of more than fifty percent was achieved.

Is this increase the result of the choice of the starting data? By starting relatively closely to what the end-result is going to be, there is clearly a danger of 'overlooking' an even better 'optimum' solution.

Two approaches were taken to test for the presence of that problem. First the real data were reshuffled -the real expenditure was allocated to different products, as shown in table 8.7. The results indicated that the gross profit was slightly reduced to £6.504 million, a reduction of £3000. This deviation was less than one percent. More importantly, the expenditure was allocated to the same sets of products, segments and media. The individual value of the allocated expenditure fluctuates by no more than ten percent.

To test for an extreme case, the initial data set was altered to cater for almost total allocation of the budget to product 5, the sales force, and the segment 'Early Majority'. A nominal sum was allocated to direct mail in segment 'Early Majority' and product 1. Again the gross profit figure achieved deviated by £2000 (table 8.8) from the original result. Although a significantly higher number of iterations was necessary, the same set of products, segments and media were selected for the allocation of the budget. Again the deviation of the absolute expenditures from the first result was less than ten percent.

The results of these two extreme sets of starting data have validated the contention that the choice of the starting data has a negligible impact on the optimum allocation of the budget. The results are robust.

8.7 Summary

Following the market segmentation procedures explained in the previous chapters this chapter has focused upon the allocation of the marketing budget to those segments identified, the product portfolio and the promotional tools available.

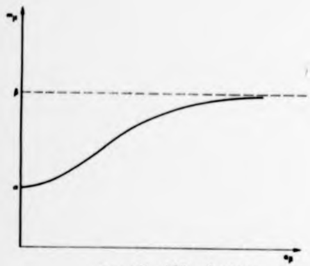
In fact, this chapter has tested hypothesis H5 which stated that:

> A model can be used to support the optimum allocation of the marketing budget across products, segments and promotional tools.

Based on a review of marketing decision support systems which concluded that there is a gap in the literature to cater for the problems specified (Chapter seven), a model has been developed to bridge the existing gap. Based on the experience reported in the literature the parameterisation of the model was achieved with the assistance of subjective estimation. The optimisation procedure developed has been explained before the results of an example using five products, five segments and three promotional tools have been displayed and discussed.

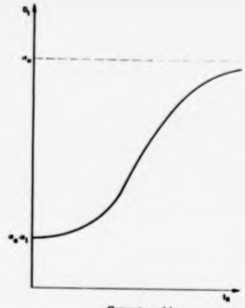
The results suggested that a considerable increase in gross profits can be achieved by re-allocating a fixed budget. The initial solution suggested that this can be achieved by significantly cutting expenditure on sales force. However, these savings can often not be realised in the short term. To test for the implications of treating large parts of the sales force expenditure as fixed, the model was constrained to allow for various levels of constant current expenditure. Although a drop in profit was noticeable, the changes were far smaller than expected. The gross profit figures achieved were still well above fifty percent higher compared to the current profit levels. This suggests that the majority of the extra profit was achieved by allocating the effort more accurately to the right products and target segments.

The conclusion of this chapter is that hypothesis H5 is accepted; it is possible to use a model to support the optimum allocation of the marketing budget across products, segments and promotional tools.



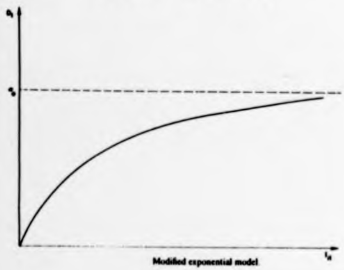
$m_p = \alpha + (\beta - \alpha)a_p^\delta/(\gamma + a_p^\delta)$, and $\delta > 1$.

Decision Calculus Model



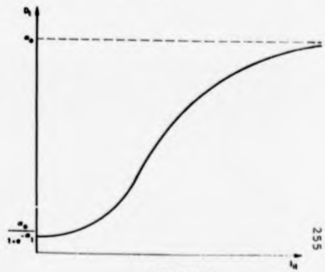
Gompertz model.

$D_t = \alpha_0 \cdot \alpha_1^{\alpha_2^{t_a}}$.



Modified exponential model.

$D_t = \alpha_0(1 - e^{-\alpha_1 t_a})$.



Logistic model.

$D_t = \dfrac{\alpha_0}{1 + e^{-(\alpha_1 + \alpha_2 t_a)}}$.

Figure 8.1 Models

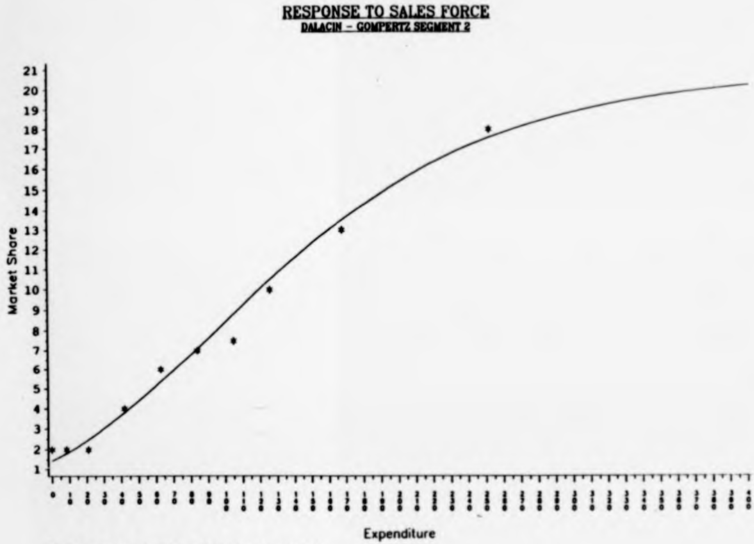


Figure 8.2 Example of Gompertz Model

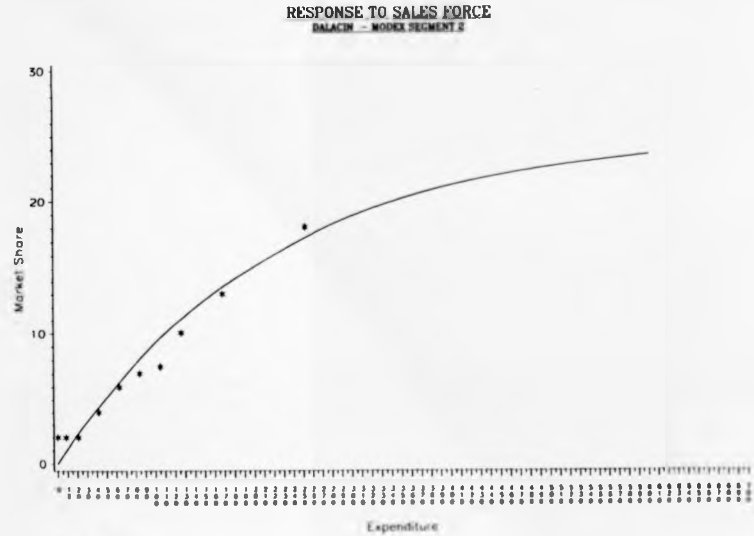


Figure 8.3 Example of Modified Exponential Model

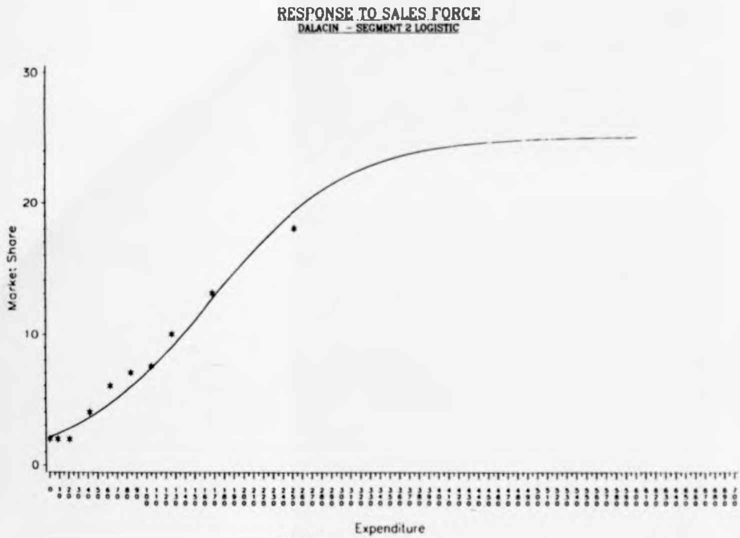


Figure 8.4 Example of Logistic Model

1. What is the forecast market share?

2. What is the ultimate market share if expenditure is increased to saturation?

3. What is the lowest level market share will reach if expenditure is reduced to zero?

4. Budget expenditure?

5. Market share next period if:

   Budget expenditure increased by 200%

   Budget expenditure increased by 100%

   Budget expenditure increased by 50%

   Budget expenditure increased by 25%

   Budget expenditure decreased by 25%

   Budget expenditure decreased by 50%

   Budget expenditure decreased by 75%

   Budget expenditure decreased by 100%

Table 8.1 Questions for a new product

1. What is the current market share?

2. What is the ultimate market share if expenditure is increased to saturation?

3. What is the lowest level market share will reach if expenditure is reduced to zero?

4. Maintenance expenditure?

5. Market share next period if:

    Maintenance expenditure increased by 200%

    Maintenance expenditure increased by 100%

    Maintenance expenditure increased by 50%

    Maintenance expenditure increased by 25%

    Maintenance expenditure decreased by 25%

    Maintenance expenditure decreased by 50%

    Maintenance expenditure decreased by 75%

    Maintenance expenditure decreased by 100%

Table 8.2 Questions for an established product

	a_0	a_1	a_2	R^2
AD	65.0	1.119	0.9629	97.1
DM	65.0	1.168	0.8918	98.9
SF	70.0	1.414	0.9946	93.5
DM	65.0	1.168	0.5479	99.0
SF	70.0	1.414	0.9720	93.5
DM	66.0	1.130	0.6619	97.4
SF	72.0	1.671	0.9720	96.3
DM	67.0	1.204	0.2873	98.9
SF	75.0	1.900	0.9557	98.0
DM	62.0	1.047	0.8454	99.7
SF	68.0	1.228	0.9909	98.8
DM	65.0	1.168	0.3852	98.9
SF	65.0	1.199	0.9731	95.6
AD	1.8	10.092	0.9519	89.3
DM	0.8	7.662	0.9682	97.7
SF	2.2	85.599	0.9923	89.6
DM	0.8	7.747	0.8436	87.6
SF	2.2	80.784	0.9604	90.0
DM	1.1	6.148	0.9110	96.0
SF	3.7	221.761	0.9656	92.6
DM	1.3	12.080	0.7821	98.3
SF	4.5	469.656	0.9217	94.0
DM	0.8	7.513	0.9045	97.1
SF	2.0	62.755	0.9736	93.9
DM	0.7	3.791	0.8823	98.7
SF	1.7	66.312	0.9420	94.9
AD	43.0	3.482	0.9939	98.6
DM	35.0	1.854	0.9638	97.5
SF	32.0	1.584	0.9957	94.0
DM	35.0	1.854	0.8236	97.5
SF	32.0	1.584	0.9978	95.7
DM	50.0	2.167	0.8131	98.8
SF	54.0	1.882	0.9807	98.0
DM	30.0	2.341	0.8607	97.8
SF	40.0	2.247	0.5918	92.6
DM	30.0	2.341	0.8607	97.8
SF	35.0	2.601	0.9868	98.6
DM	13.0	2.089	0.6280	97.0
SF	15.0	1.891	0.9735	98.3
AD	7.0	6.613	0.9839	98.3
DM	7.0	6.622	0.9681	98.3
SF	10.0	9.086	0.9979	97.5
DM	7.0	6.643	0.8430	98.4
SF	10.0	9.086	0.9888	97.5
DM	10.0	4.625	0.8677	95.4
SF	15.0	13.731	0.9867	98.1
DM	13.0	9.235	0.7409	87.0
SF	20.0	14.303	0.9716	98.3
DM	4.0	2.609	0.8966	91.9
SF	8.0	8.838	0.9927	94.0
DM	4.0	2.434	0.7091	97.1
SF	10.0	10.972	0.9829	95.7
AD	13.0	3.780	0.9975	95.9
DM	13.0	3.772	0.9941	96.1
SF	15.0	8.935	0.9982	97.4
DM	13.0	3.772	0.9694	96.1
SF	15.0	8.939	0.9908	97.4
DM	18.0	3.570	0.9784	98.0
SF	21.0	14.595	0.9893	98.5
DM	20.0	3.564	0.9380	95.1
SF	26.0	18.385	0.9729	96.8
DM	12.0	4.791	0.9728	94.8
SF	12.0	11.434	0.9930	94.8
DM	10.0	5.242	0.9450	95.6
SF	9.0	8.497	0.9878	91.2

Table 8.3 Raw Data for Gompertz Model

```
                   TOTAL EXPENDITURE      1.573150
                   PRODUCT    1                  S1          S2          S3          S4          S5
Advertising          1    0.330000
Direct Mail          2    0.304490    0.000950    0.001330    0.000900    0.001400    0.000600
Sales Force          3    0.186000    0.130000    0.048000    0.125000    0.094000    0.024000
                   PRODUCT    2
                     1    0.310000
                     2    0.327900    0.001730    0.007300    0.003300    0.008400    0.003400
                     3    0.139900    0.028500    0.036050    0.019300    0.042000    0.018000
                   PRODUCT    3
                     1    0.190000
                     2    0.218400    0.003000    0.004000    0.002000    0.005600    0.002400
                     3    0.148000    0.036400    0.038400    0.016000    0.044800    0.019200
                   PRODUCT    4
                     1    0.050000
                     2    0.023300    0.004800    0.004000    0.002500    0.007000    0.003000
                     3    0.255800    0.052300    0.066000    0.027500    0.077000    0.033000
                   PRODUCT    5
                     1    0.160000
                     2    0.309100    0.013300    0.016800    0.007000    0.019600    0.008400
                     3    0.321800    0.066500    0.084000    0.035000    0.098000    0.042000
                   ITERATION   1
                   ITERATION       1 PROFIT    4.021309458   SUM       1.000000
                   CRRECT  SS     1.000000
                   INITIAL SOLUTION      4.02130946
                   ITERATION       1 PROFIT    4.021309458   SUM       1.000000
                   ITERATION     112 PROFIT    5.249834443   SUM       7.712829
                   ITERATION     113 PROFIT    5.467256616   SUM       1.302586
                   ITERATION     170 PROFIT    5.919742777   SUM       1.132827
                   ITERATION     226 PROFIT    6.098814530   SUM       0.820296
                   ITERATION     282 PROFIT    6.248842613   SUM       1.530877
                   ITERATION     340 PROFIT    6.294647726   SUM       1.072942
                   ITERATION     341 PROFIT    6.312225080   SUM       1.095327
                   ITERATION     397 PROFIT    6.385526238   SUM       1.082902
                   ITERATION     399 PROFIT    6.407053753   SUM       1.092736
                   ITERATION     400 PROFIT    6.426993082   SUM       1.119703
                   ITERATION     456 PROFIT    6.434141280   SUM       1.009067
                   ITERATION     512 PROFIT    6.436828131   SUM       0.936597
                   ITERATION     513 PROFIT    6.455402847   SUM       0.965626
                   ITERATION     569 PROFIT    6.464725697   SUM       1.127066
                   ITERATION     627 PROFIT    6.466213188   SUM       1.049163
                   ITERATION     683 PROFIT    6.469188097   SUM       1.032648
                   ITERATION     740 PROFIT    6.473456140   SUM       1.017190
                   ITERATION     797 PROFIT    6.480392280   SUM       1.009803
                   ITERATION     798 PROFIT    6.487606973   SUM       1.024327
                   ITERATION     854 PROFIT    6.492881295   SUM       0.990674
                   ITERATION     911 PROFIT    6.497362601   SUM       1.009328
                   ITERATION     968 PROFIT    6.500426899   SUM       1.012546
                   ITERATION    1025 PROFIT    6.502662003   SUM       1.005766
                   ITERATION    1082 PROFIT    6.503900420   SUM       1.004442
                   ITERATION    1252 PROFIT    6.505166644   SUM       1.001326
                   ITERATION    1481 PROFIT    6.506203636   SUM       0.999216
                   IFAIL=  0
                   CRRECT  SS     0.999999
                   LOWER BOUND FACTOR FOR ADVERTISING IS        0.0000
                   LOWER BOUND FACTOR FOR MAIL   SHOT IS        0.0000
                   LOWER BOUND FACTOR FOR SALES FORCE IS        0.0000
                     FINAL SOLUTION      6.50724354
                   TOTAL EXPENDITURE      1.573150
                   PRODUCT    1
Advertising          1    0.000000        S1          S2          S3          S4          S5
Direct Mail          2    0.043026    0.007321    0.012077    0.004444    0.015552    0.003632
Sales Force          3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
                   PRODUCT    2
                     1    0.089202
                     2    0.021214    0.010255    0.000000    0.010959    0.000000    0.000000

                     3    0.087275    0.000000    0.087275    0.000000    0.000000    0.000000
                   PRODUCT    3
                     1    0.433882
                     2    0.156903    0.034294    0.037267    0.034673    0.039022    0.011307
                     3    0.011032    0.000000    0.000000    0.011032    0.000000    0.000000
                   PRODUCT    4
                     1    0.310366
                     2    0.320089    0.000000    0.011094    0.009745    0.000000    0.000000
                     3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
                   PRODUCT    5
                     1    0.300000
                     2    0.459768    0.186712    0.175403    0.066523    0.106667    0.042464
                     3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
```

Table 8.4 Results of the optimisation procedure

```
TOTAL EXPENDITURE      1.573150
PRODUCT   1
  1     0.008000
  2     0.004650     0.000950     0.001200     0.000500     0.001400     0.000600
  3     0.186000     0.038000     0.048000     0.020000     0.056000     0.024000
PRODUCT   2
  1     0.010000
  2     0.027900     0.005700     0.007200     0.003000     0.008400     0.003600
  3     0.139500     0.028500     0.036000     0.015000     0.042000     0.018000
PRODUCT   3
  1     0.150000
  2     0.018600     0.003800     0.004800     0.002000     0.005600     0.002400
  3     0.148800     0.030400     0.038400     0.016000     0.044800     0.019200
PRODUCT   4
  1     0.050000
  2     0.023300     0.004800     0.006000     0.002500     0.007000     0.003000
  3     0.255800     0.052300     0.066000     0.027500     0.077000     0.033000
PRODUCT   5
  1     0.160000
  2     0.065100     0.013300     0.016800     0.007000     0.019600     0.008400
  3     0.325500     0.066500     0.084000     0.035000     0.098000     0.042000
ITERATION  1
ITERATION     1 PROFIT    4.021309458   SUM       1.000000
CRRECT  55    1.000000
INITIAL SOLUTION      4.02130946
ITERATION     1 PROFIT    4.021309458   SUM       1.000000
ITERATION   112 PROFIT    5.571686381   SUM       1.996530
ITERATION   168 PROFIT    5.610612477   SUM       0.839535
ITERATION   224 PROFIT    5.691145415   SUM       0.930740
ITERATION   225 PROFIT    5.708112595   SUM       1.779915
ITERATION   282 PROFIT    5.726341499   SUM       1.046999
ITERATION   283 PROFIT    5.801222530   SUM       1.292427
ITERATION   341 PROFIT    5.891319348   SUM       1.622343
ITERATION   400 PROFIT    5.900057621   SUM       1.410754
ITERATION   458 PROFIT    5.958442558   SUM       1.262561
ITERATION   459 PROFIT    5.978261899   SUM       1.281991
ITERATION   516 PROFIT    5.983305778   SUM       0.976865
ITERATION   572 PROFIT    6.055107676   SUM       1.007625
ITERATION   573 PROFIT    6.069466272   SUM       1.108195
ITERATION   630 PROFIT    6.074869328   SUM       1.049727
ITERATION   686 PROFIT    6.101815917   SUM       1.011028
ITERATION   688 PROFIT    6.112322297   SUM       0.994150
ITERATION   744 PROFIT    6.116910806   SUM       1.020075
ITERATION   800 PROFIT    6.126111511   SUM       1.019131
ITERATION   856 PROFIT    6.130127596   SUM       1.009142
ITERATION   912 PROFIT    6.132586461   SUM       1.011430
ITERATION   969 PROFIT    6.135833949   SUM       1.012021
ITERATION   970 PROFIT    6.139124247   SUM       1.009234
ITERATION  1026 PROFIT    6.141334815   SUM       0.997924
IFAIL=  0
CRRECT  55    1.000000
LOWER BOUND FACTOR FOR ADVERTISING IS        0.0000
LOWER BOUND FACTOR FOR MAIL  SHOT  IS        0.0000
LOWER BOUND FACTOR FOR SALES FORCE IS        1.0000
  FINAL SOLUTION      6.14228135
TOTAL EXPENDITURE      1.573150
PRODUCT   1
  1     0.000000
  2     0.017109     0.003171     0.005533     0.002646     0.004127     0.001631
  3     0.186000     0.038000     0.048000     0.020000     0.056000     0.024000
PRODUCT   2
  1     0.061756
  2     0.000000     0.000000     0.000000     0.000000     0.000000     0.000000
  3     0.139500     0.028500     0.036000     0.015000     0.042000     0.018000
PRODUCT   3
  1     0.086604

  2     0.138863     0.031695     0.033376     0.031373     0.033029     0.009390
  3     0.148800     0.030400     0.038400     0.016000     0.044800     0.019200
PRODUCT   4
  1     0.000000
  2     0.044823     0.012779     0.018953     0.013091     0.000000     0.000000
  3     0.255800     0.052300     0.066000     0.027500     0.077000     0.033000
PRODUCT   5
  1     0.000000
  2     0.168396     0.042998     0.086266     0.039131     0.000000     0.000000
  3     0.325500     0.066500     0.084000     0.035000     0.098000     0.042000
```

Table 8.5 Results when sales force completely constrained

```
TOTAL EXPENDITURE     1.573150
PRODUCT   1
  1    0.008000
  2    0.004650    0.000950    0.001200    0.000500    0.001400    0.000600
  3    0.186000    0.038000    0.048000    0.020000    0.056000    0.024000
PRODUCT   2
  1    0.010000
  2    0.027900    0.005700    0.007200    0.003000    0.008400    0.003600
  3    0.139500    0.028500    0.036000    0.015000    0.042000    0.018000
PRODUCT   3
  1    0.150000
  2    0.018600    0.003800    0.004800    0.002000    0.005600    0.002400
  3    0.148800    0.030400    0.038400    0.016000    0.044800    0.019200
PRODUCT   4
  1    0.050000
  2    0.023300    0.004800    0.006000    0.002500    0.007000    0.003000
  3    0.255800    0.052300    0.066000    0.027500    0.077000    0.033000
PRODUCT   5
  1    0.160000
  2    0.065100    0.013300    0.016800    0.007000    0.019600    0.008400
  3    0.325500    0.066500    0.084000    0.035000    0.098000    0.042000
ITERATION  1
ITERATION      1 PROFIT    4.021309458   SUM      1.000000
CRRECT  55    1.000000
INITIAL SOLUTION      4.02130946
ITERATION      1 PROFIT    4.021309458   SUM      1.000000
ITERATION    112 PROFIT    5.627174000   SUM      2.622115
ITERATION    113 PROFIT    5.701600626   SUM      1.209536
ITERATION    169 PROFIT    5.787222288   SUM      1.019403
ITERATION    225 PROFIT    5.954880273   SUM      0.778614
ITERATION    281 PROFIT    6.084886584   SUM      1.169070
ITERATION    282 PROFIT    6.093122884   SUM      1.257358
ITERATION    343 PROFIT    6.112473322   SUM      1.160768
ITERATION    399 PROFIT    6.167805596   SUM      1.126841
ITERATION    401 PROFIT    6.169842970   SUM      1.124853
ITERATION    458 PROFIT    6.198080011   SUM      1.081355
ITERATION    514 PROFIT    6.214218449   SUM      1.041869
ITERATION    515 PROFIT    6.220085984   SUM      1.015097
ITERATION    571 PROFIT    6.235569400   SUM      1.011693
ITERATION    574 PROFIT    6.240267259   SUM      1.016149
ITERATION    630 PROFIT    6.242070775   SUM      1.019553
ITERATION    686 PROFIT    6.248113798   SUM      0.986996
ITERATION    742 PROFIT    6.250435356   SUM      1.008453
ITERATION    800 PROFIT    6.251476747   SUM      1.009328
ITERATION    913 PROFIT    6.253175371   SUM      1.000169
ITERATION    972 PROFIT    6.255185942   SUM      1.006188
ITERATION   1031 PROFIT    6.256488079   SUM      0.997665
ITERATION   1145 PROFIT    6.257948438   SUM      0.999544
ITERATION   1259 PROFIT    6.259146145   SUM      0.998614
IFAIL=  0
CRRECT  55    0.999999
LOWER BOUND FACTOR FOR ADVERTISING IS      0.0000
LOWER BOUND FACTOR FOR MAIL  SHOT  IS      0.0000
LOWER BOUND FACTOR FOR SALES FORCE IS      0.8000
  FINAL SOLUTION      6.25959104
TOTAL EXPENDITURE     1.573150
PRODUCT   1
  1    0.000000
  2    0.020773    0.003798    0.006562    0.002908    0.005617    0.001887
  3    0.148800    0.030400    0.038400    0.016000    0.044800    0.019200
PRODUCT   2
  1    0.067246
  2    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
  3    0.111600    0.022800    0.028800    0.012000    0.033600    0.014400
PRODUCT   3
  1    0.157203
  2    0.138324    0.031385    0.033348    0.030957    0.033200    0.009434
  3    0.119040    0.024320    0.030720    0.012800    0.035840    0.015360
PRODUCT   4
  1    0.081079
  2    0.033662    0.007856    0.014605    0.011201    0.000000    0.000000
  3    0.204640    0.041840    0.052800    0.022000    0.061600    0.026400
PRODUCT   5
  1    0.000000
  2    0.230384    0.052661    0.099571    0.043399    0.034754    0.000000
  3    0.260400    0.053200    0.067200    0.028000    0.078400    0.033600
```

Table 8.6 Results when sales force constrained to 80%

```
PRODUCT   1
  1    0.150000
  2    0.018600     0.003800     0.004800     0.002000     0.005600     0.002400
  3    0.148800     0.030400     0.038400     0.016000     0.044800     0.019200
PRODUCT   2
  1    0.250000
  2    0.023300     0.004800     0.006000     0.002500     0.007000     0.003000
  3    0.255800     0.052300     0.066000     0.027500     0.077000     0.033000
PRODUCT   3
  1    0.160000
  2    0.065100     0.013300     0.016800     0.007000     0.019600     0.008400
  3    0.325500     0.066500     0.084000     0.035000     0.098000     0.042000
PRODUCT   4
  1    0.008000
  2    0.004650     0.000950     0.001200     0.000500     0.001400     0.000600
  3    0.186000     0.038000     0.048000     0.020000     0.056000     0.024000
PRODUCT   5
  1    0.010000
  2    0.027900     0.005700     0.007200     0.003000     0.008400     0.003600
  3    0.139500     0.028500     0.036000     0.015000     0.042000     0.018000
ITERATION   1
ITERATION      1 PROFIT     5.570757134   SUM        1.000000
CRRECT  55    1.000000
INITIAL SOLUTION       5.57075713
ITERATION      1 PROFIT     5.570757134   SUM        1.000000
ITERATION    112 PROFIT     5.896103807   SUM        1.349864
ITERATION    169 PROFIT     5.914922308   SUM        1.284578
ITERATION    170 PROFIT     5.920387240   SUM        1.263123
ITERATION    171 PROFIT     5.938119537   SUM        1.142818
ITERATION    228 PROFIT     5.945189453   SUM        1.141363
ITERATION    229 PROFIT     5.948950269   SUM        1.140888
ITERATION    230 PROFIT     5.982649040   SUM        1.144919
ITERATION    231 PROFIT     5.988032480   SUM        1.246759
ITERATION    232 PROFIT     5.999766538   SUM        1.163258
ITERATION    289 PROFIT     6.233796819   SUM        1.061934
ITERATION    290 PROFIT     6.295048212   SUM        1.044584
ITERATION    291 PROFIT     6.370004312   SUM        1.043391
ITERATION    347 PROFIT     6.412293078   SUM        1.095771
ITERATION    403 PROFIT     6.440842504   SUM        0.933655
ITERATION    459 PROFIT     6.465902877   SUM        1.030765
ITERATION    515 PROFIT     6.483734789   SUM        1.038452
ITERATION    573 PROFIT     6.488509602   SUM        1.033291
ITERATION    630 PROFIT     6.491501196   SUM        1.007814
ITERATION    686 PROFIT     6.497245628   SUM        0.977209
ITERATION    742 PROFIT     6.500289355   SUM        1.016375
ITERATION    798 PROFIT     6.502902753   SUM        1.011456
ITERATION    855 PROFIT     6.504389721   SUM        0.995257
ITERATION    969 PROFIT     6.506104843   SUM        0.989558
ITERATION   1142 PROFIT     6.507202841   SUM        0.999674
IFAIL=  0
CRRECT  55    1.000000
LOWER BOUND FACTOR FOR ADVERTISING IS       0.0000
LOWER BOUND FACTOR FOR MAIL  SHOT  IS       0.0000
LOWER BOUND FACTOR FOR SALES FORCE IS       0.0000
  FINAL SOLUTION      6.50799250
TOTAL EXPENDITURE      1.573150
PRODUCT   1
  1    0.000000
  2    0.043814     0.007431     0.012237     0.004497     0.015947     0.003702
  3    0.000000     0.000000     0.000000     0.000000     0.000000     0.000000
PRODUCT   2
  1    0.092517
  2    0.031863     0.010743     0.021120     0.000000     0.000000     0.000000
  3    0.045251     0.000000     0.000000     0.045251     0.000000     0.000000
PRODUCT   3
  1    0.445263
  2    0.157622     0.034520     0.037419     0.034966     0.039315     0.011402
  3    0.011115     0.000000     0.000000     0.011115     0.000000     0.000000
PRODUCT   4
  1    0.214740
  2    0.020820     0.000000     0.011065     0.009754     0.000000     0.000000
  3    0.000000     0.000000     0.000000     0.000000     0.000000     0.000000
PRODUCT   5
  1    0.000000
  2    0.510145     0.108942     0.178512     0.069572     0.109271     0.043849
  3    0.000000     0.000000     0.000000     0.000000     0.000000     0.000000
```

Table 8.7 Results when starting data re-shuffled

```
OPTIMISATION OVER  55  VARIABLES
TOTAL EXPENDITURE      1.579100
PRODUCT   1
  1    0.000000
  2    0.006000    0.000000    0.006000    0.000000    0.000000    0.000000
  3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
PRODUCT   2
  1    0.000000
  2    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
  3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
PRODUCT   3
  1    0.000000
  2    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
  3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
PRODUCT   4
  1    0.000000
  2    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
  3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
PRODUCT   5
  1    0.000000
  2    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
  3    1.573100    0.000000    1.573100    0.000000    0.000000    0.000000
ITERATION  1
CRRECT  55    1.000000
INITIAL SOLUTION    -2.54021883
ITERATION    549 PROFIT    0.005561000    SUM       1.032686
ITERATION    550 PROFIT    0.039798331    SUM       1.058988
ITERATION    606 PROFIT    0.050431753    SUM       1.092177
ITERATION    662 PROFIT    0.054196648    SUM       1.046639
ITERATION    774 PROFIT    0.056910976    SUM       1.032892
ITERATION    831 PROFIT    0.058578037    SUM       1.037476
ITERATION    887 PROFIT    0.060480250    SUM       1.022294
ITERATION    888 PROFIT    0.061529260    SUM       1.002737
IFAIL=  0
CRRECT  55    1.000000
LOWER BOUND FACTOR FOR ADVERTISING IS       0.0000
LOWER BOUND FACTOR FOR MAIL  SHOT  IS       0.0000
LOWER BOUND FACTOR FOR SALES FORCE IS       1.0000
  FINAL SOLUTION     0.06205215
TOTAL EXPENDITURE      1.579100
PRODUCT   1
  1    0.000000
  2    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
  3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
PRODUCT   2
  1    0.000000
  2    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
  3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
PRODUCT   3
  1    0.000000
  2    0.006000    0.000000    0.006000    0.000000    0.000000    0.000000
  3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
PRODUCT   4
  1    0.000000
  2    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
  3    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
PRODUCT   5
  1    0.000000
  2    0.000000    0.000000    0.000000    0.000000    0.000000    0.000000
  3    1.573100    0.000000    1.573100    0.000000    0.000000    0.000000
```

Table 8.8 Results with extreme starting data

Chapter 9 IMPLEMENTATION

9.1 Introduction

The previous chapters explained the need for focusing promotional effort in the pharmaceutical industry and the need to segment the GP market (chapter three), introduced segmentation concepts (chapter four), presented a dynamic (chapter five) and a static (chapter six) approach to market segmentation, reviewed relevant marketing models (chapter seven), before finally a solution for the resource allocation was suggested (chapter eight). The aim of this chapter is to highlight some issues that are related to the implementation of the various analyses.

Work on this study started in January 1985; since then the various findings of the work have been reported to the Company's management. This allowed the observation of responses to the findings. These are discussed in three steps. Firstly, the issue of market segmentation as a marketing management problem. Secondly, the implementation of the segmentation study for sales force direction. Finally issues related to the budget allocation procedure.

Clearly, all these issues are interrelated but can be structured along these lines.

9.2 Market Segmentation

Market segmentation is certainly one of the most important aspects of strategic market planning as Abell and Hammond (1979, p.49) observed. Although the company distinguished between high and low prescribers, no formal segmentation of the GP market was applied. This can be explained by the fact that it is difficult to apply a pure marketing philosophy to pharmaceutical markets.

In the pharmaceutical industry it is not as straight forward a process to give customers products they want as it is in other industries. Mainly due to the long product development process, including the time consuming approval process, marketing management is often reduced to selling existing products in the most effective way. In an international company the individual subsidiaries are even more restricted as far as product developments are concerned. With a US based parent company the Company in question is definitely no exception.

As outlined in chapter three the sales force is the most important factor in the promotional mix. Consequently, the influential position of the sales department adds to the sales orientation of the Company.

This process is further enhanced by the spread of the Company's product portfolio. The products are applied in different therapeutic classes, hence appeal to a variety of doctors. Consequently, sales management felt that, at the end of the day, they had to communicate to each and every doctor in the country. This attitude is probably best summarised in a sales philosophy as: 'The more doctors we see, the higher our sales are going to be.'

Market segmentation, as a marketing management tool, clearly will lead to a less wasteful allocation of resources.

The project's official start, the first few months were spent with familiarisation with the industry and a review of marketing decision support systems, coincided with the Company's adoption of a new sales force targeting system. As explained in chapter three, the STARS database is the basis for providing the sales force with detailed information on individual doctors. The adoption of this system, including the call card system, clearly reflects the Company's desire to improve call effectiveness.

Very appealing to sales management in this context was the ability to identify individual GPs who fulfil certain criteria. As explained in chapter 3.6, however, users become quickly disillusioned with this facility once they discover that with only a few criteria the data set is sometimes very small indeed.

This disillusion was enhanced further by the remoteness. All data manipulations have to be run on a mainframe computer. Consequently, the basic benefit of adopting the use of the STARS database has been the enhanced information base for the sales force. Apparently the implementation went smoothly and was well received by the sales force.

In the early stages of the adoption of the STARS database the proposal was made to use this system not only for targeting but rather for segmentation and targeting. Consequently, the data described in chapter 3.6 were obtained. This was done with marketing management's and the managing director's backing but against the reservation of sales management, who thought that they had enough to do with the implementation of the targeting system.

A lengthy process followed to incorporate the data into a manageable form. Quite frequently the limits of the computing facilities were tested and various technical problems had to be solved. In the context of sales management's scepticism about sample size, and validity of conclusions drawn from samples, it became clear that further enlargements of the sample size were clearly out of question.

Interviews with marketing managers, sales managers and market researchers were conducted to gain an understanding of what kind of segments to expect to find. This process not only enhanced the author's understanding but also focused the minds of personnel involved on the project's issues and basically enhanced a mutual understanding. When the first segmentation results were presented, the seven cluster solution was shown along with a nine cluster solution. This nine cluster solution was very appealing since it showed a breakdown of the two most interesting segments the 'Early Majority' and the 'High Energy' group.

Management found both solutions appealing, but the more precise classification in the nine cluster solution was favoured. But the desire for detail must be balanced with managerial aspects. The segments need to have a certain size in order to make it worthwhile to pursue different strategies. Further validation procedures as discussed in chapter six led to the adoption of the seven cluster solution. Throughout the discussions it has always been very helpful to managers to label the groups with catchphrases such as 'Thrifty Housewives', etc., to make the segments come to life and make the exercise less of a statistical analysis.

Although the results of the segmentation analysis were obtained on the basis of a sample, it is possible to use the description to allocate the remainder of the data base into the seven segments. Using discriminant analysis to arrive at a description of the segments other doctors can be allocated with up to 80% confidence. This result was achieved by allocating the members of the hold-out sample to the clusters identified following the procedure outlined in the validation section in chapter six.

9.3 Sales Force Direction

Apart from the implications for marketing management outlined in the previous section, particular attention was given to implementing the segmentation results to direct sales force efforts.

Each salesperson has to cover approximately 700 doctors in the allocated sales area. Since he/she can only see up to five doctors in a day, the afternoon is spent with chemists and doctors in hospitals, it theoretically takes 140 working days to see all the doctors in the area. If it was possible to focus the attention on those doctors who are worth visiting, i.e. high potential prescribers who are responsive to promotional effort, then those could be seen much more frequently than just once or twice a year. It is therefore interesting to examine how the salesperson actually selects the doctors to be seen.

Apparently, each representative enjoys a high degree of freedom in selecting doctors. He/she is given guidance as to which products to promote but to whom, is basically up to the representative. There is, of course, a control mechanism in that each representative's performance is measured against the actual sales in the allocated area. However, there is usually a lag of up to six weeks until he/she has seen the feedback. On the other hand, there is a commission element in the pay, enabling sales management to link special promotional programmes with incentives.

Therefore, each representative is inclined to see the most promising doctors anyway, but through his/her own effort. Clearly, under these circumstances there is a danger of approaching doctors who are either easy to see or are present 'customers' already. Consequently, high potential doctors might be overlooked due to their being difficult to approach and/or their preference for a competitive product.

With the representatives heavily relying on the STARS data, the new targeting system based on the questionnaire used in this analysis, there is, additionally, the danger that they overlook doctors on whom no data are available in the STARS database.

The analyses reported here touch on two issues related to the direction of the sales force. One is the additional information on the call card as to which segment a doctor belongs. The other issue is the allocation of doctors to segments on which no information is available.

The former issue is related to the actual practicalities of using the segments in the field. The latter is important because one third of the population is not covered by the STARS database. Is it therefore feasible for the representative, with the help of his/her sales manager to allocate the 'missing' doctors into the classification?

These two issues were tackled in field work. The author was given the opportunity to spend a week visiting GPs with a sales representative of the Company. This field work was used to 'validate' the statistical analysis in trying to actually meet a real 'Dr. Average' or 'Young Conservative'. Although of little statistical relevance, it was a very rewarding exercise to test the plausibility of the recommendations.

Sales management accepted the idea that there are differences in the prescribing patterns of doctors. However, from an implementation point of view they thought that a seven segment solution was by far too complicated. They opted for a two cluster solution, combining 'Young Conservatives', 'Thrifty Housewives', 'Odd Balls', and 'Quasi Homeopaths' into the group that they should not see and the other into a second group with potential.

Although at this level the findings were obviously watered down, it is at least a first step to formally differentiating between doctors who deserve a lot of attention and others who do not.

Marketing management, however, had to face the challenge of the considerable threat to the long term success of their business in the existence of the large group of 'Young Conservatives'. A special marketing programme for this important group for the future had to be developed.

The work on this thesis has supported hypotheses H2 and H3. The implementation has demonstrated that segmentation can be used to allocate sales effort and it has been shown that such segmentation procedures can be implemented in practice.

9.4 Implementation of the Allocation Model

Marketing management had been the department with the most involvement during the project's duration. The members were, therefore, already familiar with the segments, when in the last phase of the project the focus turned towards the allocation model.

As described in the previous chapter, the model was supposed to allocate resources to products, segments and media. Although management obviously had experience in allocating resources to products and media, the aspect of segments was completely new. However, two interesting aspects emerged during the estimation process of the model: managers were forced to discuss and to justify their expectations of the outcomes of certain levels of spending, and thus were forced to formally outweigh the pros and cons of promotional expenditure in general. Secondly, it reinforced the results of the segmentation study, in that the managers started to think of the market as a sum of segments. By deciding that one group would be more responsive than others, suddenly the value of the segmentation study became apparent but also the value of proper allocation emerged as an important issue.

During the process of subjective estimation these insights occurred. Two full days were spent subjectively estimating the response curves for products, segments, and media. Three decision makers from the Company were involved: the marketing manager, the market research manager, and a senior brand manager. The estimation process was conducted with the assistance of a program written on Lotus 1-2-3, which enabled the display of an individual response curve as the data were estimated. Thus, it was possible to instantly see and judge whether a proposed data selection made sense and represented a logical approximation of the managers' beliefs.

It is obvious, that after initial difficulties, the segments were a completely new dimension, the managers became more familiar with the concept. Although, a very time consuming and tiresome exercise, all parties involved felt that they gained a better understanding of the market and moreover, of their own decision making process. As a result these managers seemed to be more committed than ever to implementing some of the findings.

The results of the optimisation procedure were not easily obtained. The rather complex relationship of the elements of the promotional mix required a lengthy inter-active process until the model specified in section 8.2 was determined.

The implementation of the optimisation procedure was by far more difficult than expected. This was due to hardware as well as software problems. The NAG routines used were by no means user friendly. In a complex situation which requires the simultaneous optimisation of fifty-five variables it is often very difficult to distinguish whether unsuccessful runs are due to flaws in the model specification, due to mistakes in the software configuration, or plainly results of insufficient hardware. In the process of developing the model, all these problems occurred, often not in isolation.

The consequence of these difficulties has been that the optimisation procedure required substantially more time than anticipated. This meant that when the results were obtained, a number of changes had taken place. Firstly, the results were obviously out of date. This problem can be overcome by convincing management of the benefits of repeating the estimation exercise and the subsequent recalculation of the optimisation procedure. Secondly, changes on the management structure led to the appointment of a new marketing manager. This process obviously does not allow for the continuity desired for a smooth implementation.

9.5 Summary

This chapter has highlighted some of the observations made with respect to the implementation of this study's findings.

The conclusion is that the concept of market segmentation is fairly new to this pharmaceutical company due to its sales orientation. Restrictions on promotional expenditure and the advent of powerful databases, however, enhanced the desire and the ability to be more accurate in the marketing effort. Product managers and marketing managers in the case reported here are satisfied that the segments identified are a meaningful representation of the market place. Involving them in discussing the various levels of segments has enhanced their commitment in subscribing to the ideas presented.

It is more difficult to implement segmentation for sales force direction. It is possible to add information to the call card used in the sales force with regards to which segment a doctor belongs.

However, this will only benefit the sales force direction when the appropriate training is provided.

As an intermediary step the Company decided to use the segmentation study to allocate the doctors into two groups, those who are worth seeing and those who are not. This is at least a step towards implementation and it is hoped that, with more experience with the call card system and the segmentation study, the findings will be implemented to direct sales force effort more effectively.

Work on the budget allocation part of the project reinforced the implementation of the segmentation study. The estimation of response curves for segments forced the managers involved to have a better understanding of the segments' profiles.

Subjective estimation was found to be a valuable tool in gaining understanding and commitment from the managers involved. This process was very much enhanced by using Lotus 1-2-3 implemented tools which allowed the assessment of 'What if?' scenarios. Using the graphic facilities the estimation could visually be checked.

The results of the optimisation procedure were out of date when presented to the Company, therefore little can be said about implementation of this aspect of the project. The process, however, developed in this thesis starting with the subjective estimation will have to be followed through again in order to develop a budget allocation model which can be implemented in the current financial year.

The work on this thesis has supported hypotheses H2 and H3. The implementation has demonstrated that segmentation can be used to allocate sales effort and it has been shown that such segmentation procedures can be implemented in practice. As far as implementation of the budget allocation procedure is concerned it is too early to conclude from observation.

CHAPTER 10 CONCLUSION

This thesis set out to test the following hypotheses based on the UK pharmaceutical market :

H1 Segmentation can be used to allocate sales effort.

H2 Such segmentation procedures can be implemented in practice.

H3 It is possible to define market segments on the basis of response to marketing stimuli.

H4 It is possible to define static segments which reflect dynamic behaviour.

H5 A model can be used to support the optimum allocation of the marketing budget across products, segments and promotional tools.

With respect to these hypotheses the findings are:

1. Hypothesis H1 is accepted. As demonstrated in chapters six and eight, segments in pharmaceutical markets can be used to direct the sales force effort more effectively.

2. Hypothesis H2 is accepted. As discussed in chapter nine, with the help of comprehensive databases it is possible to implement segmentation procedures in practice.

3. Hypothesis H3 is rejected. With the use of the data available it could not be sufficiently proven that it is possible to define market segments on the basis of response to marketing stimuli (chapter five).

4. Hypothesis H4 is accepted. As demonstrated in chapter six it can be shown that segments identified on the basis of static information reflect dynamic behaviour. Thus, these static segments show a significant difference in response to marketing stimuli. Hence these segments represent a meaningful way of classifying the market.

5. Hypothesis H5 is accepted. As discussed in chapter eight a model is developed which can be used to support decision making in the allocation of the marketing budget to products, segments and promotional tools.

The work reported in this thesis spans a number of areas in marketing theory, the ultimate objective being to develop a model assisting in budget allocation decisions. This work is obviously closely related to research into decision support systems. A review of the literature on decision support systems with particular emphasis on marketing decision support systems was provided in chapter two. There it was concluded that the way the term DSS is used in this thesis would follow Stabell's (1987) distinction between the various DSS 'schools' and would be called the decision calculus approach. This approach to DSS research puts the focus closely on the development of models as the heart of a DSS.

With the objective of modelling budget allocation problems to products, segments and promotional tools, one important problem needs to be addressed first, the segmentation of the market in question. While the products and the promotional tools can be treated as given, segments are not necessarily easily defined. Chapter three set out to explain the background to this case, a Company operating in the UK pharmaceutical industry. It was concluded that segments in the GP market are not obvious, hence the need to undertake a segmentation study.

Chapter four provided an overview of the literature on segmentation research with the objective of identifying appropriate bases of segmenting the GP market.

Chapter five aimed to identify segments within the GP population on the basis of response to marketing stimuli. This is important because if segmentation is conducted with the ultimate objective of an optimal allocation of the marketing budget, then clearly the response to these very promotional tools is the best basis for segmentation. However, mainly due to limitations in the data, only two sets of 'snap shots' over time rather than time series data were available; segments identified to be responsive were too small to be of any significance.

As a separate finding, this chapter reported on evidence which indicates that promotional expenditure has a stronger role in maintaining an existing customer base rather than in gaining new customers.

Chapter six discussed two static approaches to segmenting the GP marketing. The macro analysis across doctors' prescribing pattern in all therapeutic classes for which data were available identified seven segments. It was concluded that these segments displayed a different degree of attractiveness for pharmaceutical companies. It is shown that these segments are meaningful because it could be proven that there is a significant difference in the response to marketing stimuli.

The micro analysis, however, demonstrated how the market within a therapeutic class can be segmented. By applying this technique a useful insight for brand positioning can be gained.

Since the overall objective has been to identify segments in the GP population in a more general way, the seven segments identified in the macro analysis were used in the model building.

The foundation to the model was presented in chapter seven. Based on a review of the literature on marketing models, a gap in the literature was detected with respect to the allocation of marketing resources to segments. The application of subjective estimation was seen to be common in parameterising models which were closest to solving the problems discussed in this thesis. Subsequently, elements of subjective estimation were outlined.

Chapter eight examined the application of a model. The model's specification was outlined and its parameterisation explained. The various parameters were determined, particularly with the help of subjective estimation conducted by marketing managers. Subsequently the optimisation procedure was outlined and the results explained.

An increase in gross profit in excess of fifty percent was feasible when the fixed budget was re-allocated to the most promising set of products, segments and promotional tools. This re-allocation of the budget was primarily achieved at the expense of expenditure on the sales force, which was reduced significantly. When it is accepted that in the short term no significant changes in sales force expenditure can be undertaken, the model is flexible to allow for an additional constraint in the form of a fixed proportion of current expenditure. Even a re-allocation of the budget with 80% of sales force expenditures being fixed achieved an increase in gross profit in excess of 50%.

The implementation of the various analyses has been discussed in chapter nine. There it was concluded that the segmentation study was welcomed as an additional benefit to the introduction of a new database targeting system. For the allocation model, however, it is too early to comment. Change in key managerial positions has not necessarily eased the implementation of the new decision support system.

Limitations and Future Research

As far as the segmentation study is concerned, the methodology employed has proven to be successful.

Although the definition of static segments eases implementation because it is easier and quicker to conduct, response to marketing stimuli remains a key issue in segmentation research. In this thesis it is shown that the static segments identified displayed differences in response to marketing stimuli, thus a balance of ease of use and utility is achieved.

However, segmentation on the basis of response should be tried directly. With the database used it should even be possible to conduct this more successfully than it was possible in this analysis. In the future, the database will be more frequently updated, which means that more data over a longer period of time will be available. Although it will never be as accurate as times series data, an analysis of change in preference over time relative to promotional spending should be more accurate once, say, four responses to the questionnaire are available compared to two in this case.

The segmentation study itself has identified segments which warrant further research. The group of 'Young Conservatives' are a large and important group of doctors for the future. Pharmaceutical companies need to understand better what doctors in this segment want and how they can be approached. Additional market research could also produce some important insights into the prescribing behaviour of doctors in the currently highly attractive segments of 'Early Majority' and 'High Energy'. These doctors account for a large number of prescriptions and are very attractive targets for pharmaceutical companies. For example it would be worth monitoring their prescribing behaviour over time to test hypotheses with respect to their innovativeness and brand loyalty.

In addition, the stability of segments over time has to be established. Obviously, the accuracy of the allocation model is dependent on the validity of the segments identified. However, the model is adaptable to cater for any number and types of segments which may be identified in the future as long as the response to promotional expenditure is determined for the changing or evolving segments.

The results of the optimisation procedure indicate that considerable increases in expenditures on direct mail and advertising at the expense of sales force expenditure would lead to significant increases in gross profits. It has to be established whether the effectiveness of direct mail and advertising has not been exaggerated when estimating the response to expenditure.

The effectiveness of relevant promotional tools has to be investigated further in particular in the light of the findings reported in chapter five. There, some evidence for a defensive role of promotional expenditure was reported. It could not be established that promotional expenditure helped significantly in gaining new customers.

Analysing the response to promotional expenditure using time series data and econometric models would help gaining a better understanding of the relative importance of a promotional tool. This knowledge could be used as an input in re-estimating the response to promotional expenditure. By increasing the quality of the estimates it is expected to improve the quality of output of the budget allocation model.

The limitations of the model at the heart of the decision support system are best discussed against the criteria set by Little (1970) as outlined in chapter two.

He postulated that a DSS should be simple, robust, easy to control, adaptive, as complete as possible and easy to communicate with. These aspects will be discussed in turn:

<u>Simple</u>: the basic structure of a model needs to be easy to understand. The basic structure of the model developed here is not too complex. However, simplicity is obviously hampered by the desire to model complex interaction effects. Hence the model can be judged as being simple considering the complexities modelled.

<u>Robust</u>: absurd answers, such as a market share in excess of one hundred percent are not possible in this model. It can be judged to be robust.

<u>Easy to Control</u>: it should not be too difficult to understand the kind of input data required. However, when re-calibrating the model, an experienced outside communicator should be present.

<u>Adaptive</u>: the model is within reason adaptable to new information. For example, new knowledge about the size of the budget available, the degree of flexibility in terms in change compared with previous expenditure, or limits on market shares achievable can be incorporated fairly easily. The re-estimation of response to marketing stimuli is also possible but requires substantially more effort and time.

Work recently reported by Fraser and Hite (1988) could provide an interesting starting point for integrating information from experience with information from models in what they labelled 'an adaptive utility approach'.

Completeness: this criterion examines whether important phenomena are included in the model. From a list of criteria compiled for marketing mix models (Lilien and Kotler 1983 p. 663) some are applicable in this case.

The most obvious criterion is interaction between the promotional tools. This aspect has been tackled satisfactorily. However, the model does not explicitly incorporate competitive effects or lag-effects of expenditure. Competitive effects are indirectly included since the judgemental determination of response curves to promotional expenditure inevitably takes competitors' moves into account.

Lag-effects are currently not included, but this is an area where future research could quite easily fill the gap. This is primarily important once the implementation is progressed and the desire for an increase in sophistication is present.

Another area where future research could be beneficial is the aspect of incorporating various levels of effectiveness for expenditures.

The model is currently complete in incorporating vital phenomena. There is, however, room for developing it further to include lag-effects and different levels of effectiveness of expenditure.

Communication

Following the procedure used in STRATPORT (Larreche and Srinivasan 1981) it is attempted to combine subjective estimation and optimisation. The optimisation routine, however, is run on a mainframe computer. This prohibits the use by management as explained in chapter two. However, the model is easily transferable to Lotus 1-2-3. This obviously will not allow optimisation procedures, but will allow the test of various What if? scenarios.

The use of the model could thus be in two steps: establishing the optimum solution on the mainframe computer, then taking the results for What If? tests on to Lotus 1-2-3 to examine for the sensitivity of the findings. From an implementation point of view this facility is obviously paramount in achieving successful adoption (C.F. chapter two). Only this facility will actually bridge the gap between the user and the developer and should avoid the pitfalls of early operational research models which tended to neglect this issue. This aspect of the implementation takes a step forward from a 'model' to a 'Decision Support System'.

APPENDICES

Annual Medical Census

1. In my practice, I like to try a promising new drug :
   - A ___ During clinical trials before it's released for general use
   - B ___ As soon as it' released
   - C ___ After a few of my colleagues have tried it successfully
   - D ___ Once it is in fairly common use
   - E ___ Only after it becomes a standard drug

2. The number of prescriptions I write in an average week is :
   - A ☐ None
   - B ☐ 1 - 200
   - C ☐ 201 - 300
   - D ☐ 301 - 500
   - E ☐ 501 +

3. The number of patients I see in my practice in an average week is :
   - A ☐ None
   - B ☐ 0 - 75
   - C ☐ 76 - 150
   - D ☐ 151 - 300
   - E ☐ 301 +

4. The number of pharmaceutical representatives I will see in an average week is :
   - A ☐ None
   - B ☐ 1
   - C ☐ 2
   - D ☐ 3
   - E ☐ 4
   - F ☐ 5 +

5. The total number of patients of the practice is :
   - A ☐ under 2000
   - B ☐ 2001 - 4500
   - C ☐ 4501 - 7000
   - D ☐ 7001 - 9500
   - E ☐ 9501 - 12000
   - F ☐ 12001 +

6. The number of patients for whom I am personally responsible is :
   - A ☐ under 1000
   - B ☐ 1001 - 1750
   - C ☐ 1751 - 2500
   - D ☐ 2501 - 3250
   - E ☐ over 3251

Please refer to the attached instruction sheet before filling out the remainder of the questionnaire

ANALGESICS

08 NON-NARCOTIC ANALGESICS

G☐ Do not prescribe in this class

Rx's Per Week

<1 A☐ | 1-9 B☐ | 10-16 C☐ | 17-24 D☐ | 25+ E☐

Product(s) Used

27 ____ Acupan
01 ____ aspirin (Generic)
02 ____ aspirin nuseals (Generic)
03 ____ Calpol
04 ____ codeine phosphate (Generic)
05 ____ Codis
06 ____ Cosalgesic
07 ____ Disprin
08 ____ DF 118
09 ____ Distalgesic
10 ____ Dolobid
11 ____ Equagesic
12 ____ Fortagesic
13 ____ Fortral
28 ____ Meptid
14 ____ Panadeine Co
15 ____ Panadol
16 ____ Paracodol
17 ____ Parahypon
18 ____ paracetamol (Generic)
19 ____ Paramol
20 ____ Ponstan/Ponstan Kapseals
21 ____ Progesic
22 ____ Safapryn
23 ____ Solpadeine
24 ____ Solprin
25 ____ Syndol
26 ____ Temgesic
99 ____ Other: ______________

09 ANTI-MIGRAINE PREPS

G☐ Do not prescribe in this class

Rx's Per Week

<1 A☐ | 1 B☐ | 2 C☐ | 3 D☐ | 4+ E☐

Product(s) Used

09 ____ Cafergot
01 ____ Dixarit
10 ____ Inderal
02 ____ Migraleve
08 ____ Migravess
03 ____ Migril
04 ____ Paramax
07 ____ propranolol (Generic)
05 ____ Sanomigran
06 ____ Stemetil
99 ____ Other: ______________

GI PREPARATIONS

10 SYNTHETIC GI ANTISPASMOL

G☐ Do not prescribe in this class

Rx's Per Week

<1 A☐ | 1 B☐ | 2 C☐ | 3 D☐ | 4+ E☐

Product(s) Used

01 ____ Buscopan
02 ____ Colofac
07 ____ Colpermin
06 ____ Imodium
08 ____ Libraxin
05 ____ Lomotil
03 ____ Merbentyl
04 ____ Pro-Banthine
99 ____ Other: ______________

11 ANTIPEPTIC ULCERANTS

G☐ Do not prescribe in this class

Rx's Per Week

<1 A☐ | 1-2 B☐ | 3-4 C☐ | 5-6 D☐ | 7+ E☐

Product(s) Used

01 ____ Aludrox SA
02 ____ Antepsin
10 ____ Asilone
03 ____ cimetidine (Generic)
09 ____ De-Nol
04 ____ Gastrozepin
05 ____ Pyrogastrone
06 ____ ranitidine (Generic)
07 ____ Tagamet
08 ____ Zantac
99 ____ Other: ______________

12 ANTACIDS & ANTIFLATULENTS

G☐ Do not prescribe in this class

Rx's Per Week

<1 A☐ | 1-4 B☐ | 5-8 C☐ | 9-12 D☐ | 13+ E☐

Product(s) Used

01 ____ Actal
02 ____ Aludrox
03 ____ Altacite/Altacite Plus
04 ____ Asilone
05 ____ Gastrocote
06 ____ Gaviscon
07 ____ Gelusil
08 ____ Kolanticon
09 ____ Kolantyl
10 ____ Maalox
11 ____ Mag Carb Aromat
12 ____ Mag Trisilicate
16 ____ Malinal
13 ____ Mucaine
14 ____ Nulacin
15 ____ Polycrol
99 ____ Other: ______________

13 ANTIEMETICS - ANTINAUSEANTS

G☐ Do not prescribe in this class

Rx's Per Week

<1 A☐ | 1 B☐ | 2 C☐ | 3 D☐ | 4+ E☐

Product(s) Used

01 ____ Avomine
02 ____ Dramamine
03 ____ Maxolon
04 ____ metoclopramide (Generic)
08 ____ Motilium
05 ____ Serc
06 ____ Stemetil
07 ____ Stugeron
99 ____ Other: ______________

38 ANTIDIARRHOEALS - ADULTS

G☐ Do not prescribe in this class

Rx's per Week

<1 A☐ | 1 B☐ | 2 C☐ | 3 D☐ | 4+ E☐

01 ____ Dioralyte
02 ____ Imodium
03 ____ Kaolin
04 ____ Kaolin et Morph
06 ____ Lomotil
05 ____ Rehidrat
99 ____ Other: ______________

39 ANTIDIARRHOEALS - CHILDREN

G☐ Do not prescribe in this class

Rx's per Week

<1 A☐ | 1 B☐ | 2 C☐ | 3 D☐ | 4+ E☐

01 ____ Dioralyte
02 ____ Imodium
03 ____ Kaolin
04 ____ Kaolin et Morph
06 ____ Lomotil
05 ____ Rehidrat
99 ____ Other: ______________

Appendix 1 contd.

CARDIOVASCULAR PREPARATIONS

16 SYNTHETIC HYPOTENSIVES

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-2	3-4	5-6	7+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Aldomet
02 ____ Apresoline
03 ____ Baratol
04 ____ Catapres
05 ____ Declinax
06 ____ hydralazine (Generic)
07 ____ Hypovase
08 ____ Ismelin
09 ____ methyldopa (Generic)
10 ____ prazosin HCl (Generic)
99 ____ Other: ____________

17 PERIPHERAL VASODILATORS

G☐ Do not prescribe in this class

Rx's Per Week

<1	1	2	3	4+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Cyclospasmol
02 ____ Duvadilan
03 ____ Hexopal
04 ____ Opilon
05 ____ Praxilene
06 ____ Stugeron
07 ____ Trental
99 ____ Other: ____________

18 MYOCARDIAL THERAPY

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-3	4-5	6-9	10+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Adalat
02 ____ Cedocard
03 ____ Cardilox
04 ____ glyceryl trinitrate (Generic)
05 ____ Isordil
06 ____ isosorbide dinitrate (Generic)
07 ____ Monit
08 ____ nifedipine (Generic)
15 ____ Nitrolingual
09 ____ Pentrate
10 ____ Persantin
11 ____ Sorbichew
12 ____ Sorbitrate
13 ____ Sustac
14 ____ Transiderm-Nitro
99 ____ Other: ____________

BETABLOCKERS

19 COMBINATIONS

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-2	3-4	5-6	7+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Co Betaloc
02 ____ Corgaretic
03 ____ Inderetic
04 ____ Inderex
15 ____ Lopressor SR
16 ____ Lopresoretic
05 ____ Moducren
06 ____ Prestim
07 ____ Secadrex
08 ____ Sotazide
09 ____ Spiroprop
10 ____ Tenoret 50
11 ____ Tenoretic
12 ____ Trasidrex
13 ____ Viskaldix
99 ____ Other: ____________

20 PLAIN

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-3	4-6	7-9	10+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ atenolol (Generic)
02 ____ Beta Cardone
03 ____ Betaloc
04 ____ Blocadren
05 ____ Corgard
06 ____ Inderal
07 ____ Lopresor
08 ____ metoprolol (Generic)
09 ____ oxprenolol (Generic)
10 ____ propranolol (Generic)
11 ____ Sectral
16 ____ Slow-Trasicor
12 ____ Sotacor
13 ____ Tenormin
14 ____ Trandate
15 ____ Trasicor
99 ____ Other: ____________

DIURETICS

21 THIAZIDES (Inc Combinations)

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-3	4-5	6-9	10+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Aldactide
02 ____ Aprinox
03 ____ bendrofluazide (Generic)
04 ____ Centyl K
05 ____ Dyazide
06 ____ Moduretic
11 ____ Navidrex
07 ____ Navidrex K
08 ____ Neo Naclex
09 ____ Neo Naclex K
10 ____ Neptinal
99 ____ Other: ____________

22 OTHER DIURETICS

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-2	3-4	5-7	8+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Aldactone
02 ____ amiloride (Generic)
03 ____ Baycaron
04 ____ Burinex K
05 ____ Diamox
06 ____ Diumide K
07 ____ Durexan
08 ____ frusemide (Generic)
09 ____ Hygroton (K)
10 ____ Lasikal
11 ____ Lasix (K)
12 ____ Midamor
13 ____ Natrilix
14 ____ spironolactone (Generic)
99 ____ Other: ____________

23 NON-STEROIDAL ANTIRHEUMATICS

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-4	5-9	10-14	15+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Alrheumat
02 ____ Benoral
03 ____ Brufen
04 ____ Clinoril
05 ____ Feldene
06 ____ Fenopron
07 ____ Froben
08 ____ ibuprofen (Generic)
09 ____ Indocid
10 ____ Indocid R
11 ____ indomethacin (Generic)
12 ____ Lederfen
13 ____ Naprosyn
14 ____ naproxen (Generic)
15 ____ Orudis
16 ____ Oruvail
17 ____ penicillamine (Generic)
18 ____ Ponstan
19 ____ Rheumox
20 ____ Surgam
21 ____ Synflex
23 ____ Voltarol
24 ____ Voltarol Retard
99 ____ Other: ____________

24 HYPNOTICS & SEDATIVES

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-4	5-7	8-11	12+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Amytal
02 ____ Bellergal
03 ____ Dalmane
04 ____ Dorden
21 ____ Dormonoct
05 ____ Euhypnos
06 ____ Halcion
07 ____ Heminevrin
08 ____ Mogadon
09 ____ Nembutal
10 ____ nitrazepam (Generic)
11 ____ Noctamid
12 ____ Normison
13 ____ phenobarbitone (Generic)
14 ____ Rohypnol
15 ____ Sodium Amytal
16 ____ Soneryl
17 ____ temazepam (Generic)
18 ____ Trancopal
19 ____ Tuinal
20 ____ Welldorm
99 ____ Other: ____________

25 TRANQUILLISERS

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-3	4-7	8-11	12+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Anxon
02 ____ Ativan
03 ____ chlordiazepoxide (Generic)
04 ____ diazepam (Generic)
05 ____ Equanil
06 ____ Frisium
07 ____ Lexotan
08 ____ Librium
09 ____ lorazepam (Generic)
10 ____ Nobrium
11 ____ Serenid D
12 ____ Tranxene
13 ____ Valium
14 ____ Xanax
99 ____ Other: ____________

26 ANTI-DEPRESSANTS

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-2	3-4	5-6	7+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ amitriptyline (Generic)
02 ____ Anafranil
03 ____ Bolvidon
22 ____ Fluanxol
23 ____ Gamanil
04 ____ imipramine (Generic)
21 ____ Lentizol
05 ____ Limbitrol
06 ____ Ludiomil
07 ____ Merital
08 ____ mianserin (Generic)
09 ____ Molipaxin
10 ____ Motipress
11 ____ Motival
12 ____ Norval
13 ____ Parstelin
14 ____ Prondol
15 ____ Prothiaden
16 ____ Sinequan
17 ____ Surmontil
18 ____ Tofranil
19 ____ Triptafen DA/Triptafen Minor
20 ____ Tryptizol
99 ____ Other: ____________

27 CONTRACEPTIVES : ORAL

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-3	4-6	7-9	10+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Brevinor
02 ____ Binovum
03 ____ Conova 30
04 ____ Eugynon 30
05 ____ Femulen
06 ____ Gynovlar 21
07 ____ Loestrin 20
08 ____ Logynon
09 ____ Marvelon
10 ____ Microgynon 30
11 ____ Micronor
12 ____ Microval
13 ____ Minilyn
14 ____ Minovlar
15 ____ Neogest
16 ____ Norday
23 ____ Norimin
17 ____ Norinyl 1
18 ____ Ovran 30
19 ____ Ovranette
20 ____ Ovysmen
21 ____ Trinordiol
22 ____ Trinovum
99 ____ Other: ____________

28 LAXATIVES

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-2	3	4	5+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

16 ____ Agiolax
01 ____ Alophen
02 ____ Celevac
03 ____ Dorbanex
04 ____ Dulcolax
05 ____ Duphalac
06 ____ Fybogel
07 ____ Glycerin
08 ____ Isogel
15 ____ Laxoberal
09 ____ Normacol
10 ____ Normax
11 ____ Paraffin Liquid
12 ____ Proctofibe
13 ____ Regulan
14 ____ Senokot
99 ____ Other: ____________

Appendix 1

COUGH/COLD PREPARATIONS

29 COUGH SEDATIVES

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-3	4-8	9-12	13+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Actifed CO
02 ____ ammon chlor morph (Generic)
03 ____ Benafed
04 ____ Benylin & Codeine
05 ____ codeine (Generic)
06 ____ Davenol
07 ____ Dimotane & Codeine
08 ____ Expulin
09 ____ ipecac & morphine (Generic)
10 ____ Linctifed
19 ____ Linctus simplex
11 ____ Lotussin
12 ____ Phensedyl
13 ____ Pholcomed
14 ____ pholcodine (Generic)
15 ____ Pholtex
16 ____ Sancos CO
17 ____ squill opiate (Generic)
18 ____ Tixylix
99 ____ Other: ____________

30 COLD PREPARATIONS

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-3	4-8	9-12	13+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

06 ____ Actifed
01 ____ Benylin Decongestant
07 ____ Dimotapp
02 ____ Pholcolix
03 ____ Rinurel
08 ____ Sudafed
04 ____ Sudafed-Co
05 ____ Triogesic
99 ____ Other: ____________

31 EXPECTORANTS

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-2	3-4	5-6	7+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Actifed
02 ____ Alupent Expect
03 ____ Benylin/Benylin Paediatric (PD)
04 ____ Bisolvon
05 ____ Bricanyl
06 ____ Dimotane
07 ____ Fabrol
08 ____ Franol Expectorant
09 ____ ipecac ammon (Generic)
10 ____ Mucodyne
11 ____ Mucolex
12 ____ Nethaprin Expect
13 ____ Sudafed
14 ____ simple (Generic)
99 ____ Other: ____________

NASAL DECONGESTANTS

32 TOPICAL

G☐ Do not prescribe in this class

Rx's Per Week

<1	1	2	3	4+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Afrazine
02 ____ Beconase
03 ____ Dexa-Rhinaspray
04 ____ ephedrine (Generic)
05 ____ Iliadin Mini
06 ____ Naseptin
07 ____ Otrivine/Otrivine Antistin
10 ____ Rhinocort
08 ____ Rynacrom
09 ____ Syntaris
99 ____ Other: ____________

33 NASAL DECONG. & ANTIHIST. SYST.

G☐ Do not prescribe in this class

Rx's Per Week

<1	1	2	3	4+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Actifed
02 ____ Congesteze
03 ____ Dimotapp
04 ____ Eskornade
05 ____ Sudafed
06 ____ Triominic
99 ____ Other: ____________

34 ANTI-PARKINSON PREPARATIONS

G☐ Do not write in this class

Rx's Per Week

<1	1-2	3-4	5-6	7+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Artane
12 ____ bromocriptine (Generic)
02 ____ Disipal
03 ____ Eldepryl
04 ____ Kemadrin
05 ____ Larodopa
06 ____ levodopa (Generic)
07 ____ Madopar
11 ____ Parlodel
08 ____ procyclidine (Generic)
09 ____ Sinemet
10 ____ Symmetrel
99 ____ Other: ____________

Appendix 1 contd.

TOPICAL CORTICOSTEROIDS

14 PLAIN

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-6	7-10	11-15	16+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Betnovate Branded
02 ____ Betnovate (Generic)
03 ____ Dermovate
14 ____ Diprosone
04 ____ Efcortelan
05 ____ Eumovate
06 ____ Haelan
07 ____ Hydrocortisone
08 ____ Locoid
09 ____ Metosyn
10 ____ Nerisone
11 ____ Propaderm
12 ____ Synalar
13 ____ Topical Steroid
99 ____ Other ____________

15 COMBINATIONS

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-4	5-9	10-15	16+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Alphaderm
02 ____ Betnovate C
03 ____ Betnovate N
04 ____ Daktacort
15 ____ Diprosalic
05 ____ Eurax HC
06 ____ Fucidin H
07 ____ Hydroderm
14 ____ Locoid C
08 ____ Nystaform HC
16 ____ Synalar N
09 ____ Terra Cortril
10 ____ Timodine
11 ____ Tri Adcortyl
12 ____ Trimovate
13 ____ Vioform Hydrocort
99 ____ Other ____________

06 ANTIHISTAMINES SYSTEMIC

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-2	3-4	5-6	7+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Daneral
02 ____ Dimotane
13 ____ Dimotapp LA
03 ____ Fabahistin
14 ____ Haymine
04 ____ Histamenal
05 ____ Histryl
06 ____ Optimine
07 ____ Phenergan
08 ____ Piriton
09 ____ Pro Actidil
10 ____ Tavegil
11 ____ Triludan
12 ____ Vallergan
99 ____ Other ____________

07 BRONCHODILATORS-ANTIASTHMA

G☐ Do not prescribe in this class

Rx's Per Week

<1	1-4	5-7	8-11	12+
A☐	B☐	C☐	D☐	E☐

Product(s) Used

01 ____ Alupent
02 ____ Asmasal
03 ____ aminophylline (Generic)
04 ____ Atrovent
05 ____ Becloforte
06 ____ Becotide
07 ____ Berotec
08 ____ Bextasol
09 ____ Bricanyl
10 ____ Choledyl
11 ____ Duovent
12 ____ Exirel
13 ____ Franol
14 ____ Franol Plus
15 ____ Intal
16 ____ Intal Compound
17 ____ Medihaler
18 ____ Nuelin
19 ____ Phyllocontin
20 ____ Pulmadil
21 ____ Pulmicort
22 ____ salbutamol sulphate (Generic)
23 ____ Slo-Phyllin
24 ____ Uniphyllin Unicontin
25 ____ Ventide
26 ____ Ventolin
99 ____ Other ____________

THANK YOU!
Please mail this in the return envelope now, while you think of it.

Appendix 1 cont.

```
      PROGRAM MAIN
C     ALLOCATION OPTIMIZATION
C     MAIN PROGRAM
C
      COMMON /MYDATA/ GM(5), SIZE(5,6), SH(5,6), SMPS(5,6), SNOW(5,6),
     *       RMEDIUM(5,6,3),ALPHA0(5,6,3), ALPHA1(5,6,3), ALPHA2(5,6,3),
     *       RR(5,6,3), SMPSM(5,6,3),
     *       MAXPRD,MAXSEG,MAXMED
      COMMON /MINIM/ BESTIT,ICOU
      COMMON /BETCOM/ FACTOR,FACT1,FACT2,FACT3,XXSAVE(65),KMAX
      REAL  OBJF
      INTEGER I, IFAIL, ITMAX, J, N, KMAX,
     * NIN, NOUT, CMD, IWORK(1000),
     *LIWORK,LWORK
      REAL  X(6,6,3), XX(65), YY(65),  WORK(5000)
      EXTERNAL CMD
C     SET LIMITS TO THE PROBLEM
      MAXPRD=5
      MAXSEG=6
      MAXMED=3
C
C     SET FILE 20 FOR RESULTS
      I=CMD('FILEDEF 20 DISK START1 RESULT A ( RECFM F LRECL 80')
C     GET LOWER BOUND FACTOR FOR ADVERTISING
      WRITE(6,4010)
      READ(5,*) FACT1
C     GET LOWER BOUND FACTOR FOR MAIL SHOT
      WRITE(6,4020)
      READ(5,*) FACT2
C     GET LOWER BOUND FACTOR FOR SALESMAN
      WRITE(6,4030)
      READ(5,*) FACT3
C
C     GROSS MARGIN DATA IS IN A FILE CALLED GM DATA
      I=CMD('FILEDEF 1 DISK GM DATA')
      READ(1,*) (GM(I),I=1,MAXPRD)
C
C     SH DATA IS IN A FILE CALLED SHAREM2 DATA
C     I=CMD('FILEDEF 2 DISK SHAREM2 DATA')
C     DO 80 IPROD=1,MAXPRD
C       READ(2,*) SH(IPROD,1), SH(IPROD,2), SH(IPROD,3), SH(IPROD,4),
C    *          SH(IPROD,5), SH(IPROD,6)
C80   CONTINUE
C
C     MARKET SIZE DATA IS IN A FILE CALLED SIZE DATA
      I=CMD('FILEDEF 3 DISK SIZE DATA')
      DO 90 IPROD=1,MAXPRD
        READ(3,*) SIZE(IPROD,1), SIZE(IPROD,2), SIZE(IPROD,3),
     *          SIZE(IPROD,4), SIZE(IPROD,5), SIZE(IPROD,6)
   90 CONTINUE
C      READ(3,*) ((SIZE(I,J),I=1,MAXPRD),J=1,MAXSEG)
C
C     RESPONSE FUNCTION DATA IS IN A FILE CALLED  ALPHA1 DATA
      I=CMD('FILEDEF 4 DISK ALPHA1 DATA')
      DO 130 IPROD=1,MAXPRD
              READ(4,1000)
     1        M,ALPHA0(IPROD,1,1),ALPHA1(IPROD,1,1),
     2        ALPHA2(IPROD,1,1),RR(IPROD,1,1)
         DO 120 ISEG=1,MAXSEG
            DO 110 IMED=2,MAXMED
              READ(4,1000)
     1        M,ALPHA0(IPROD,ISEG,IMED),ALPHA1(IPROD,ISEG,IMED),
     2        ALPHA2(IPROD,ISEG,IMED),RR(IPROD,ISEG,IMED)
              WRITE(20,1000)
     1        M,ALPHA0(IPROD,ISEG,IMED),ALPHA1(IPROD,ISEG,IMED),
     2        ALPHA2(IPROD,ISEG,IMED),RR(IPROD,ISEG,IMED)
```

```
  110          CONTINUE
  120       CONTINUE
  130   CONTINUE
C
C       CURRENT EXPENDITURE IS IN A FILE CALLED  START DATA
        I=CMD('FILEDEF 10 DISK START DATA')
        DO 240 IPROD=1,MAXPRD
               READ(10,8500) M,X(IPROD,1,1)
               DO 220 IMED=2,MAXMED
                 READ(10,8000) M,X(IPROD,1,IMED), X(IPROD,2,IMED),
     *           X(IPROD,3,IMED), X(IPROD,4,IMED), X(IPROD,5,IMED),
     *           X(IPROD,6,IMED)
  220          CONTINUE
  240   CONTINUE
C
C       MAXIMUM SHARE DATA IS IN A FILE CALLED SMAX DATA
        I=CMD('FILEDEF 12 DISK SMAX DATA')
        DO 250 IPROD=1,MAXPRD
          READ(12,*) SMPS(IPROD,1), SMPS(IPROD,2), SMPS(IPROD,3),
     *            SMPS(IPROD,4), SMPS(IPROD,5), SMPS(IPROD,6)
  250    CONTINUE
C
C       CURRENT MARKET SHARE  DATA IS IN A FILE CALLED SNOW DATA
        I=CMD('FILEDEF 13 DISK SNOW DATA')
        DO 260 IPROD=1,MAXPRD
          READ(13,*) SNOW(IPROD,1), SNOW(IPROD,2), SNOW(IPROD,3),
     *            SNOW(IPROD,4), SNOW(IPROD,5), SNOW(IPROD,6)
  260   CONTINUE
C        READ(13,*) ((SNOW(I,J),I=1,MAXPRD),J=1,MAXSEG)
C
C       SHARE ACHIEVABLE WITH MEDIUM IS IN A FILE CALLED  MEDSHM DATA
        I=CMD('FILEDEF 14 DISK MEDSHM DATA')
        DO 280 IPROD=1,MAXPRD
                 READ(14,1000)
     1           M,SMPSM(IPROD,1,1)
           DO 270 ISEG=1,MAXSEG
              DO 265 IMED=2,MAXMED
                 READ(14,1500)
     1           M,SMPSM(IPROD,ISEG,IMED)
                 WRITE(20,1500)
     1           M,SMPSM(IPROD,ISEG,IMED)
  265         CONTINUE
  270      CONTINUE
  280   CONTINUE
        K=0
        DO 330 IPROD=1,MAXPRD
           K=K+1
           XX(K)=X(IPROD, 1,1)
           DO 320 ISEG=2,MAXSEG
              DO 310 IMED=2,MAXMED
                 K=K+1
                 XX(K)=X(IPROD, ISEG, IMED)
  310         CONTINUE
  320     CONTINUE
  330   CONTINUE
        KMAX=K
C       WRITE(20,9000) KMAX
        DO 410 I=1,KMAX
          XXSAVE(I)=XX(I)
  410   CONTINUE
        NOUT=22
C
C       CALL PROCEDURE - SPECIFICATION
C
        CALL X04ABF(1, NOUT)
        NCLIN=1
```

Appendix 2 contd

```
      LWORK=5000
      LIWORK=1000
C
C     SOLVE THE PROBLEM
C
      ITER=0
      N=KMAX
      CALL WRITXX(XX)
  999 CONTINUE
         ITER=ITER+1
         WRITE(20,7000) ITER
         CALL CONVIM(XX,YY)
         CALL RECONV(XX,YY)
         CALL FUNCT1(N,YY,OBJF)
         CALL CRRECT(N,YY,OBJF)
         IF(ITER.EQ.1) THEN
            WRITE(20,7050) OBJF
         ENDIF
         ICOU=0
         IFAIL=1
         CALL E04CGF(N,YY,OBJF,IWORK,LIWORK,WORK,LWORK,IFAIL)
         CALL RECONV(XX,YY)
         WRITE(20,6050) IFAIL
C        IF(IFAIL.NE.0) GOTO 999
      CALL CRRECT(N,YY,OBJF)
      WRITE(20,4110) FACT1
      WRITE(20,4120) FACT2
      WRITE(20,4130) FACT3
      WRITE(20,7060) OBJF
      CALL WRITXX(XX)
      STOP
 20   WRITE(NOUT,99997) IFAIL
C
 1000 FORMAT(13X,A2,10X,F7.2,F9.5,F9.5,F9.2)
 1500 FORMAT(13X,A2,13X,F4.1)
 2000 FORMAT(A2,F6.2,F5.3,F7.2,F11.2,2F10.2)
 3000 FORMAT(A2,F6.2)
 4010 FORMAT(' GIVE LOWER BOUND FACTOR FOR ADVERTISING ( 0 TO 1 )')
 4020 FORMAT(' GIVE LOWER BOUND FACTOR FOR MAIL  SHOT  ( 0 TO 1 )')
 4030 FORMAT(' GIVE LOWER BOUND FACTOR FOR SALES FORCE ( 0 TO 1 )')
 5000 FORMAT(A2,F6.2)
 4110 FORMAT(' LOWER BOUND FACTOR FOR ADVERTISING IS ',F12.4)
 4120 FORMAT(' LOWER BOUND FACTOR FOR MAIL  SHOT  IS ',F12.4)
 4130 FORMAT(' LOWER BOUND FACTOR FOR SALES FORCE IS ',F12.4)
 6000 FORMAT(A2,F6.2,F8.3,F7.2,F8.2,2F9.2)
 6050 FORMAT(' IFAIL=',I3)
 7000 FORMAT(' ITERATION',I3)
 7010 FORMAT(' ',I3,2F16.6)
 7050 FORMAT(' INITIAL SOLUTION ',F14.8)
 7060 FORMAT('   FINAL SOLUTION ',F14.8)
 8000 FORMAT(A2,F8.4,F10.5,F10.5,F10.5,F10.4,F13.4)
 8500 FORMAT(A2,F8.4)
 9000 FORMAT(' OPTIMISATION OVER ',I3,'  VARIABLES')
99996 FORMAT(' OPTIMISATION CRRECT')
99997 FORMAT(' OPTIMISATION FAILED  IFAIL=',I3)
C
      END
C
      SUBROUTINE CRRECT(N,YY,OBJF)
      REAL YY(N),OBJF,SUM
      INTEGER N,I
      SUM=0.0
      DO 100 I=1,N
         SUM=SUM+YY(I)*YY(I)
  100 CONTINUE
      WRITE(20,1000) N,SUM
```

```
      OBJF=-OBJF+(SUM-1.0)**2
      RETURN
 1000 FORMAT(' CRRECT ',I3,F12.6)
      END
C
C     CALL OPTIMIZATION SUBROUTINE
C
      SUBROUTINE FUNCT1 (N, YY, OBJF)
      COMMON /MYDATA/ GM(5), SIZE(5,6), SH(5,6), SMPS(5,6), SNOW(5,6),
     *      MEDIUM(5,6,3),ALPHA0(5,6,3), ALPHA1(5,6,3), ALPHA2(5,6,3),
     *      RR(5,6,3), SMPSM(5,6,3),
     *      MAXPRD,MAXSEG,MAXMED
      COMMON /MINIM/ BESTIT,ICOU
      INTEGER N
      REAL YY(N), OBJF
      REAL X(5,6,3),PROD,PRO, XXX, PR, PF,PI,PROFIT,XX(100), SUM
      INTEGER I, J, K, P, S
      EXTERNAL F
      ICOU=ICOU+1
      IF (ICOU.EQ.1) BESTIT=0
C
C     CREATE XX-ARRAY
C
      CALL RECONV(XX,YY)
C
C     CREATE X-ARRAY
C
      K=0
      DO 130 P=1,MAXPRD
         K=K+1
         X(P, 1, 1)=XX(K)
         DO 120 S=2,MAXSEG
            DO 110 I=2,MAXMED
               K=K+1
               X(P, S, I)=XX(K)
 110        CONTINUE
 120     CONTINUE
 130  CONTINUE
C
C     CREATE OBJECTIVE FUNCTION
C
      XXX=0
      PF=0
      PRO=1
      DO 210 P=1,MAXPRD
         PI=0
         DO 200 S=2,MAXSEG
            PROD=1.0
               PROD=PROD*((SMPSM(P,1,1)/100-(F(P,1,1,X(P,1,1))/100))/
     *                ((SMPSM(P,1,1)/100)- SNOW(P,1)))
C              PROD=PROD*((1.0-(F(P,1,1,X(P,1,1))/100))/SH(P,1))
               XXX= XXX+X(P,1,1)
            DO 150 I=2,MAXMED
               PROD=PROD*((SMPSM(P,S,I)/100-(F(P,S,I,X(P,S,I))/100))/
     *                ((SMPSM(P,S,I)/100)- SNOW(P,S)))
               XXX= XXX+X(P,S,I)
  150       CONTINUE
            PI=PI+ SIZE(P,S)*(SMPS(P,S)-(SMPS(P,S)-SNOW(P,S))*PROD)
  200    CONTINUE
         PF=PF+PI*GM(P)
  210 CONTINUE
      PROFIT=PF
      SUM=0.0
      DO 220 I=1,N
         SUM=SUM-YY(I)*YY(I)
  220 CONTINUE
```

Appendix 2 contd

```
      OBJT=-PROFIT+(SUM-1.0)**2
      IF(PROFIT.GT.BESTIT) THEN
         DIFF=PROFIT-BESTIT
         IF(DIFF.GT.1.0D-3) THEN
            BESTIT=PROFIT
            WRITE(20,9001) ICOU,BESTIT,SUM
         ENDIF
      ENDIF
      RETURN
 9001 FORMAT(' ITERATION ',I5,' PROFIT',F15.8,'    SUM',F15.6)
 9002 FORMAT(' ',6F11.8)
      END
C
C     GOMPERTZ FUNCTION
C
      FUNCTION F(P,S,I,X)
      COMMON /MYDATA/ GM(5), SIZE(5,6), SM(5,6), SMPS(5,6), SNOM(5,6),
     *       RMDIUM(5,6,3),ALPHA0(5,6,3), ALPHA1(5,6,3), ALPHA2(5,6,3),
     *       RR(5,6,3), SMPSM(5,6,3),
     *       MAXPRD,MAXSEG,MAXMED
      INTEGER P, S, I
      REAL X
      XX=ALPHA2(P,S,I)**X
      IF(XX.LE.0.0) THEN
        F=0.0
        WRITE(20,*)  'XX LESS 0', F
        RETURN
      END IF
      F=ALPHA0(P,S,I)*(ALPHA1(P,S,I)**(-(ALPHA2(P,S,I)**(X*1000))))
      RETURN
      END

      SUBROUTINE CONVIN(XX,YY)
      COMMON /MYDATA/ GM(5), SIZE(5,6), SM(5,6), SMPS(5,6), SNOM(5,6),
     *       RMDIUM(5,6,3),ALPHA0(5,6,3), ALPHA1(5,6,3), ALPHA2(5,6,3),
     *       RR(5,6,3), SMPSM(5,6,3),
     *       MAXPRD,MAXSEG,MAXMED
      COMMON /BETCOM/ FACTOR,FACT1,FACT2,FACT3,XXSAVE(65),KMAX
      REAL XX(*),YY(*)
      SUMF=0.0
      K=0
      DO 330 IPROD=1,MAXPRD
        K=K+1
        V=XX(K)-XXSAVE(K)*FACT1
        IF(V.LT.0) V=0
        YY(K)=SQRT(V)
        SUMF=SUMF+V
        DO 320 ISEG=2,MAXSEG
          DO 310 IMED=2,MAXMED
            K=K+1
            V=XX(K)
            IF(IMED.EQ.2) V=V-XXSAVE(K)*FACT2
            IF(IMED.EQ.3) V=V-XXSAVE(K)*FACT3
            IF(V.LT.0) V=0
            YY(K)=SQRT(V)
            SUMF=SUMF+V
  310     CONTINUE
  320   CONTINUE
  330 CONTINUE
      SQSUM=SQRT(SUMF)
      DO 400 I=1,KMAX
        YY(I)=YY(I)/SQSUM
  400 CONTINUE
      FACTOR=SUMF
      RETURN
      END
```

```
      SUBROUTINE RECONV(XX,YY)
      COMMON /MYDATA/ GM(5), SIZE(5,6), SH(5,6), SMPS(5,6), SNOW(5,6),
     *       RMDIUM(5,6,3),ALPHA0(5,6,3), ALPHA1(5,6,3), ALPHA2(5,6,3),
     *       RR(5,6,3), SMPSH(5,6,3),
     *       MAXPRD,MAXSEG,MAXMED
      COMMON /RETCOM/ FACTOR,FACT1,FACT2,FACT3,XXSAVE(65),KMAX
      REAL XX(*),YY(*)
      SUM=0.0
      DO 100 I=1,KMAX
         XX(I)=YY(I)*YY(I)
         SUM=SUM+XX(I)
  100 CONTINUE
      K=0
      DO 330 IPROD=1,MAXPRD
         K=K+1
         XX(K)=XX(K)/SUM*FACTOR+XXSAVE(K)*FACT1
         DO 320 ISEG=2,MAXSEG
            DO 310 IMED=2,MAXMED
               K=K+1
               XX(K)=XX(K)/SUM*FACTOR
               IF(IMED.EQ.2) XX(K)=XX(K)+XXSAVE(K)*FACT2
               IF(IMED.EQ.3) XX(K)=XX(K)+XXSAVE(K)*FACT3
  310       CONTINUE
  320    CONTINUE
  330 CONTINUE
      RETURN
      END
      SUBROUTINE WRITXX(XX)
      COMMON /MYDATA/ GM(5), SIZE(5,6), SH(5,6), SMPS(5,6), SNOW(5,6),
     *       RMDIUM(5,6,3),ALPHA0(5,6,3), ALPHA1(5,6,3), ALPHA2(5,6,3),
     *       RR(5,6,3), SMPSH(5,6,3),
     *       MAXPRD,MAXSEG,MAXMED
      INTEGER MAXPRD,MAXSEG,MAXMED,P,S,I,K
      REAL XX(*),X(5,6,3),TOTEXP
      TOTEXP=0.0
      K=0
      DO 130 P=1,MAXPRD
         K=K+1
         X(P,1,1)=XX(K)
         TOTEXP=TOTEXP+XX(K)
         DO 105 I=2,MAXMED
            X(P,1,I)=0.0
  105    CONTINUE
         DO 120 S=2,MAXSEG
            DO 110 I=2,MAXMED
               K=K+1
               X(P,S,I)=XX(K)
               X(P,1,I)=X(P,1,I)+XX(K)
               TOTEXP=TOTEXP+XX(K)
  110       CONTINUE
  120    CONTINUE
  130 CONTINUE
      WRITE(20,500) TOTEXP
      DO 230 P=1,MAXPRD
         WRITE(20,1000) P
         WRITE(20,2000) 1,X(P,1,1)
         DO 220 I=2,MAXMED
            WRITE(20,2000) I,(X(P,S,I),S=1,MAXSEG)
  220    CONTINUE
  230 CONTINUE
      RETURN
  500 FORMAT(' TOTAL EXPENDITURE ',F12.6)
 1000 FORMAT(' PRODUCT ',I3)
 2000 FORMAT(' ',I3,6F12.6)
      END
```

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TITLE

A DECISION SUPPORT SYSTEM FOR ALLOCATION OF THE MARKETING BUDGET TO PRODUCTS, SEGMENTS AND PROMOTIONAL TOOLS

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